december 1957

grinding and finishing

a hitchcock publication

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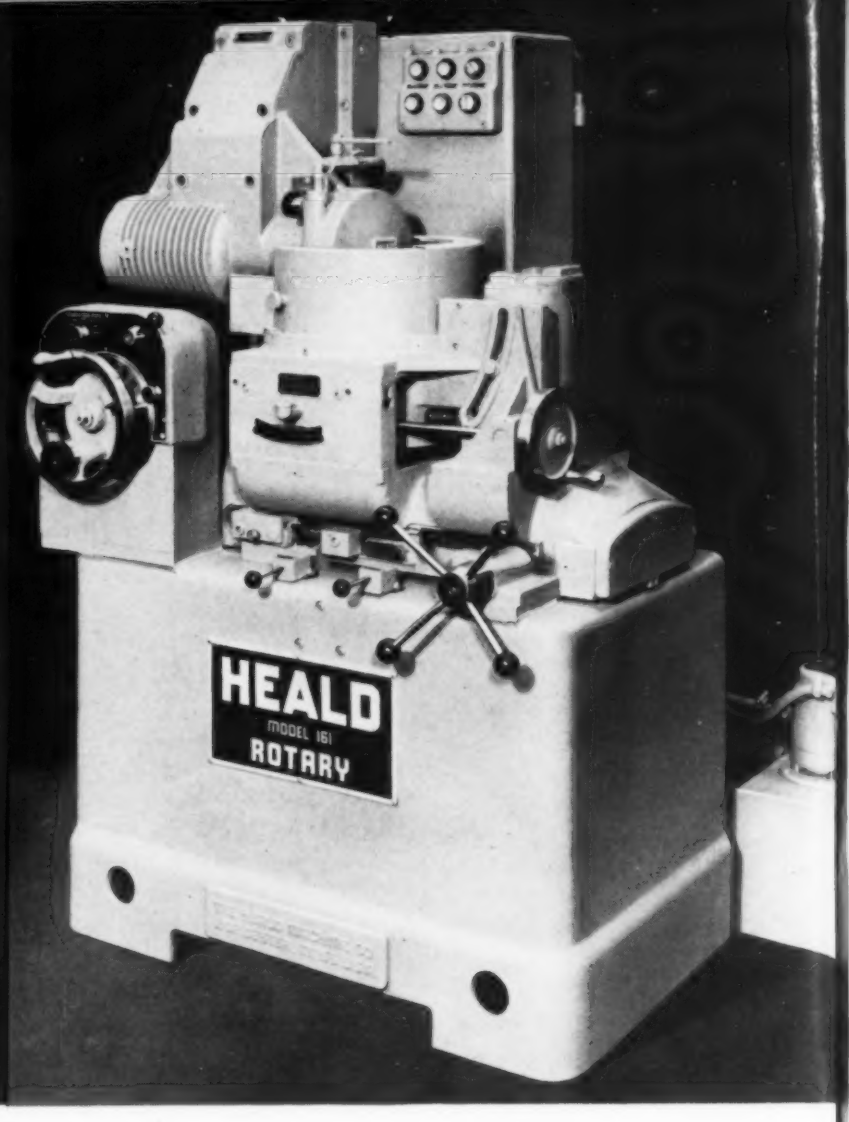
There's a NEW LOOK and NEW PERFORMANCE in this 1958 Model!



Here's what the new Model 161 Rotary can do for you...

Greater Precision — Dial knob type feed box now permits incremented feeds of .0001 from 0 to .0006 for rough grinding, changing automatically to .0001 fine feed at any point from 0 to .005 before finish size.

Finer Finish — Rugged cradle-type chuck bracket and swivel adjustment minimizes chatter. And vibration-free diamond unit gives wheel a smoother dress.

Easier Operation — Anti-friction table ways give easier manual reciprocation. Four ounce pressure moves the 590 lb. table.

Higher Production — Hydraulic table feed rates infinitely variable from 0 to 10 fpm. Permits smooth slow dressing speed, changeable instantly to rapid traverse or reciprocating speed.

Greater Versatility — A manually operated machine is easily changed over to hydraulic operation simply by adding a power pack.

Less Maintenance — Anti-friction table and base ways are grease packed for life and sealed to exclude foreign matter. Hydraulic table design minimizes spare parts inventory and reduces maintenance and attention.

The 1958 Model 161 Rotary Surface Grinder is ideally suited to all small work grinding operations, on a high production or job-lot basis. Grinds flat, convex or concave surfaces of work up to 6 in. O.D. For complete information, send today for Bulletin 2-161-2 Issue 1.

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Contents • Dec. 1957

#8

Grinding and Finishing

the magazine of abrasive metalworking operations

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BPA

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COVER: The editorial staff of Grinding and Finishing and the entire staff of Hitchcock Publishing Company wish you and yours a Merry Christmas and a jolly yuletide season.

Cincinnati Automatic W

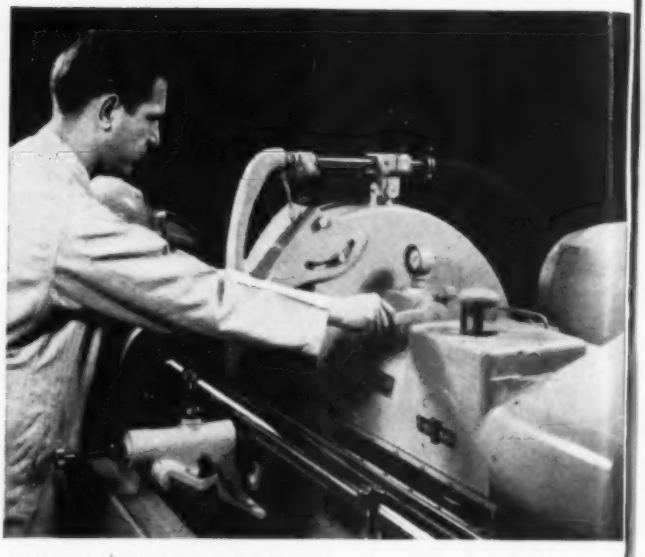
Improves the Entire G

Have you ever seen an operator balance a grinding wheel mount on conventional static balancing ways? It's a tedious operation, and may require 90 minutes or more to remove the wheel mount, balance and replace it. Cincinnati decided to do something about this. They developed automatic grinding wheel balancing . . . it does the job ten times more accurately and infinitely quicker and easier.

This exclusive Cincinnati feature automatically balances the grinding wheel mount on the machine . . . within a few seconds . . . while the spindle rotates at its operating speed. **This exclusive Cincinnati feature** eliminates vibration and resultant chatter on the work . . . permits more effective stock removal . . . reduces wheel cost per workpiece.

FILMATIC spindle bearings and automatic grinding wheel balancing constitute a team that just can't be beat for low-cost precision cylindrical grinding. Best of all, these features are standard equipment on CINCINNATI® FILMATIC 6"R, 10"L, 10"R, 14"L, 14" and 16" Plain Grinders, and on 6"R, 10"L, 10"R and 14"L Angular Wheel Slide Grinding Machines. Write today for the complete balancing story. Ask for publication No. G-637-2.

CINCINNATI GRINDERS INCORPORATED
CINCINNATI 9, OHIO



In the illustration above the operator shows how easy it is to balance the grinding wheel on a CINCINNATI FILMATIC 10"R x 72" Plain Hydraulic Grinder.

Publication No. G-637-2 explains the Cincinnati Automatic Balancing principle. Write for a copy.

CINCINNATI

CINCINNATI

Wheel Balancing

Grinding Operation

Symbol of Automatic Grinding Wheel Balancing . . . the greatest timesaving feature to be found on any precision grinding machine.

Automatic Grinding Wheel Balancing and FILMATIC Spindle Bearings are exclusive Cincinnati features . . . they just can't be beat for producing the finest finish at the lowest cost on your precision ground work.

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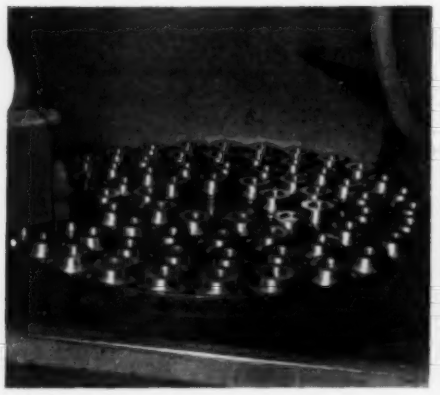
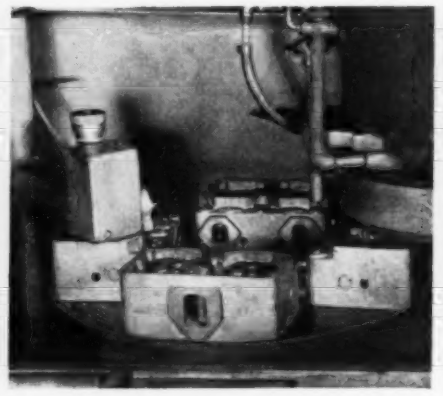
Whatever your grinding job may be...



200 adjusting screw washers are ground on one side in one hour. Stock removal .025"; limits ± .001".

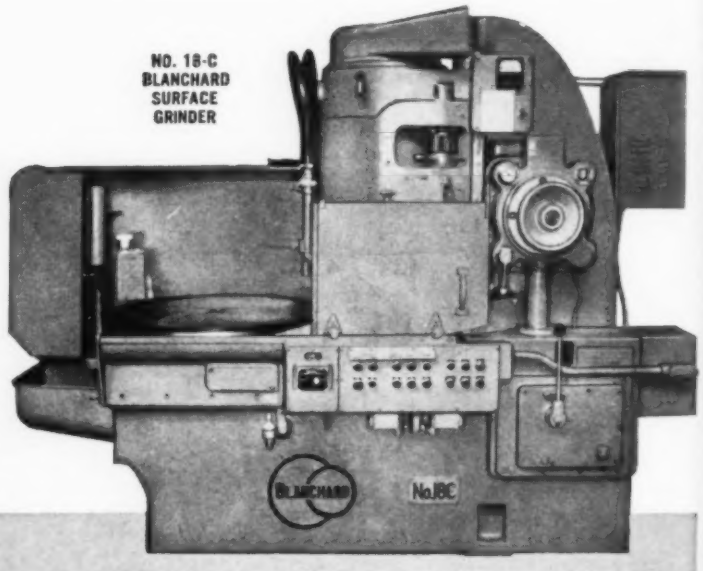


Tops of cylinder heads ground 21 per hour; stock removal 3/16" to 1/4". Bottoms 55 per hour; stock .012"; limits ± .001".

56 cast iron plates are ground on one side in one hour. Stock removal .140"; limits .001".

for best results...

The Blanchard No. 18-C Surface Grinder has the speed and precision that guarantees economical grinding on an endless variety of jobs. After the initial setup, the automatic cycle handles every operation from start to finish. The operator is freed to prepare the next load or to operate a second No. 18-C Grinder.



NO. 18-C BLANCHARD SURFACE GRINDER

Put it on the Blanchard

The 18-C Automatic Cycle...

Moves chuck to grinding position and starts it rotating

Starts wheel rotation and coolant pump

Provides rapid wheel approach to work

Engages power down-feed at preset rate

Changes to fine feed just before finished size is reached

Stops feed when work is to size—"sparks" out. Raises wheelhead

Stops wheel, coolant pump, and chuck

Moves chuck to loading position—demagnetizes chuck

Can be changed quickly to manual operation

Automatically Controls Size!

Send today for your free copy of 18-C folder.

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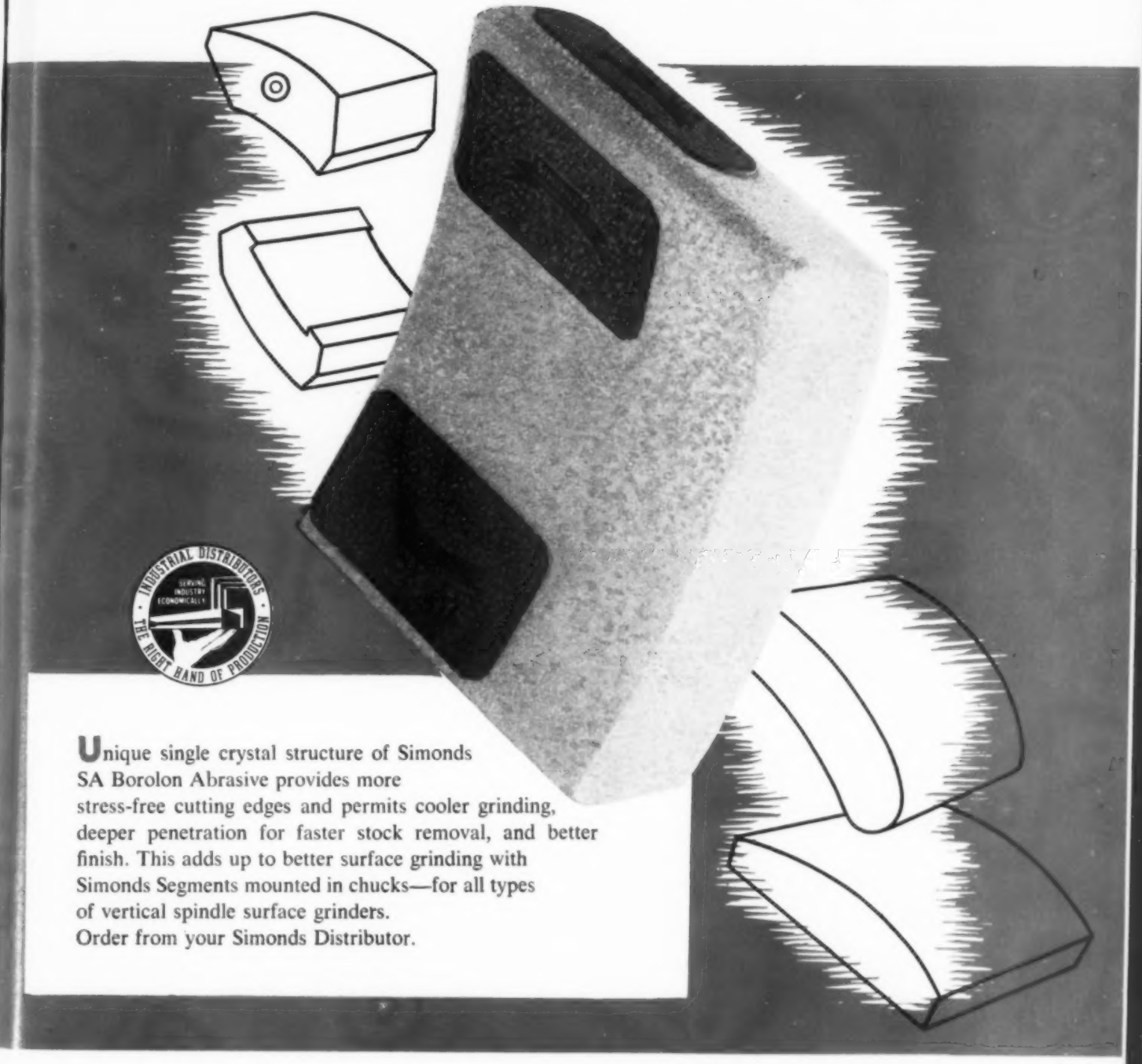
with SA Borolon® TRADE MARK . . . for faster cooler grinding . . .



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Unique single crystal structure of Simonds SA Borolon Abrasive provides more stress-free cutting edges and permits cooler grinding, deeper penetration for faster stock removal, and better finish. This adds up to better surface grinding with Simonds Segments mounted in chucks—for all types of vertical spindle surface grinders.
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Letters to the Editor

Barrel Finishing

First of all I would like to extend my sincerest appreciation for the tear sheets on "Automatic Barrel Finishing at IBM," which accompanied your letter dated September 24, 1957.

My attention has been directed to another item on barrel finishing, namely, "How Ford Aircraft Saves Money on Deburring Operations" by Mr. Herbert E. Chase, Page 23, GRINDING and FINISHING for October. Naturally, I would like tear sheets of this article for our reference library.

Needless to say, Allis-Chalmers people from top management level to plant supervisory personnel, consider GRINDING and FINISHING a sort of bible on metal finishing and consider it the best trade magazine received at our Boston Works plant.

As GRINDING and FINISHING is bound to carry articles on barrel finishing at one time or another, I would like to know if arrangements could be made whereby tear sheets would be mailed to me as the items appear in your magazine. I realize, of course, such a procedure would only add to the burden of your responsibilities, but it would help immensely as I am planning a completely automatic barrel finishing department for our plant and some of the practices described in these articles could well be introduced into our proposed system.

Eugene Pawley,
Methods and Time Study Dept.
Allis-Chalmers Mfg. Co.

COLLECTION OF TEAR SHEETS HAVE BEEN SENT.

Air Grinders

As President of the Compressed Air and Gas Institute, I would very much appreciate receiving two copies of either reprints or tear sheets of the CAGI article "How Much Does it Cost to Run Your Portable Air Grinders"—which appeared in the August 1957 issue of your magazine.

Thank you very much.

H. O. Gummere,
Executive Vice President
Buckeye Tools Corporation

IT'S A PLEASURE TO OBLIGE.

Titanium Grinding

Once again an article published in GRINDING and FINISHING is assisting me in solving manufacturing problems. I refer to the article on "Titanium Grinding" by L. C. Hays, which appears in the September issue of your magazine. I would appreciate it very much if you could send me two copies of this article. If additional copies are not available, may I have permission to reproduce two copies for our Methods Engineers.

Thank you for any consideration.

C. V. Ruehrwein,
Supervisor, Process Engineering,
General Electric Company

GLAD TO HAVE BEEN OF HELP. TEAR SHEETS SENT.

Diaphragm Chucking

We would like to secure at least two dozen reprints of the article appearing in the October 1957 issue of GRINDING and FINISHING magazine entitled "Diaphragm Chucking on Gear Production." If there is a charge for this, please use this letter as your authority to bill us.

Trusting that you can comply with our request and thanking you in advance, we are

C. K. Higley,
Sales Department
Erickson Tool Company

REPRINTS HAVE BEEN MADE OF THIS ARTICLE. THEY ARE FREE FOR THE ASKING AS LONG THEY LAST.

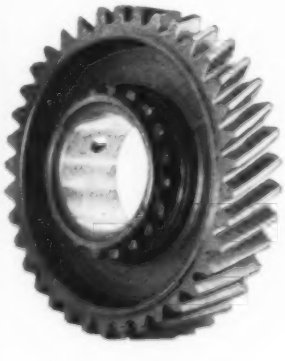
Meet BERNARD C. DAY

... one of Bryant's internal grinding experts, who helps solve grinding problems for customers throughout the Cleveland territory. Mr. Day can be reached at Center West Bldg., No. 307, 20950 Center Ridge Road, Cleveland 16, Ohio. Tel. Edison 1-9626.

Gears like these, ground on a Bryant 3216, are typical of the precision items made by Dana Corp.

Q. Why does Dana Corp., Toledo, Ohio, use eight Bryant 3216 Internal Grinders?

A. "The Bryant 3216 produces more parts for less money . . . gives better quality than manually operated machines . . . holds size consistently and finishes better."



The Toledo Division of Dana Corp., specializes in making a great variety of parts: transmissions, universal joints, propeller shafts, forgings, gear boxes and torque converters, to name only a few.

In the words of a company official, Dana is "a sort of glorified jobbing shop ... our runs are comparatively short, and quick changeover ability is a key factor in our operation."

At Dana, the Bryant 3216 Automatic Internal Grinder has proven superior to other makes. The company first bought four 3216's, and then, because of their excellent performance, bought four more.

Here are some of the things Dana likes about Bryant 3216's: —

"they're economical . . . we're able to have one man run two machines, and cost is cut to about 60% of single-machine operation."

"the 3216 holds size consistently and finishes better."

"holds tolerance very well . . . you can depend on it to do the job it is supposed to do."

"there is almost no maintenance . . . these machines have run trouble-free since we've had them."

"simple to operate . . . easy to adjust . . . hold close tolerances . . . meet all our requirements."

Learn how the Bryant 3216 Automatic or other Bryant machines can help *you* in your internal grinding operations. Write today for literature.

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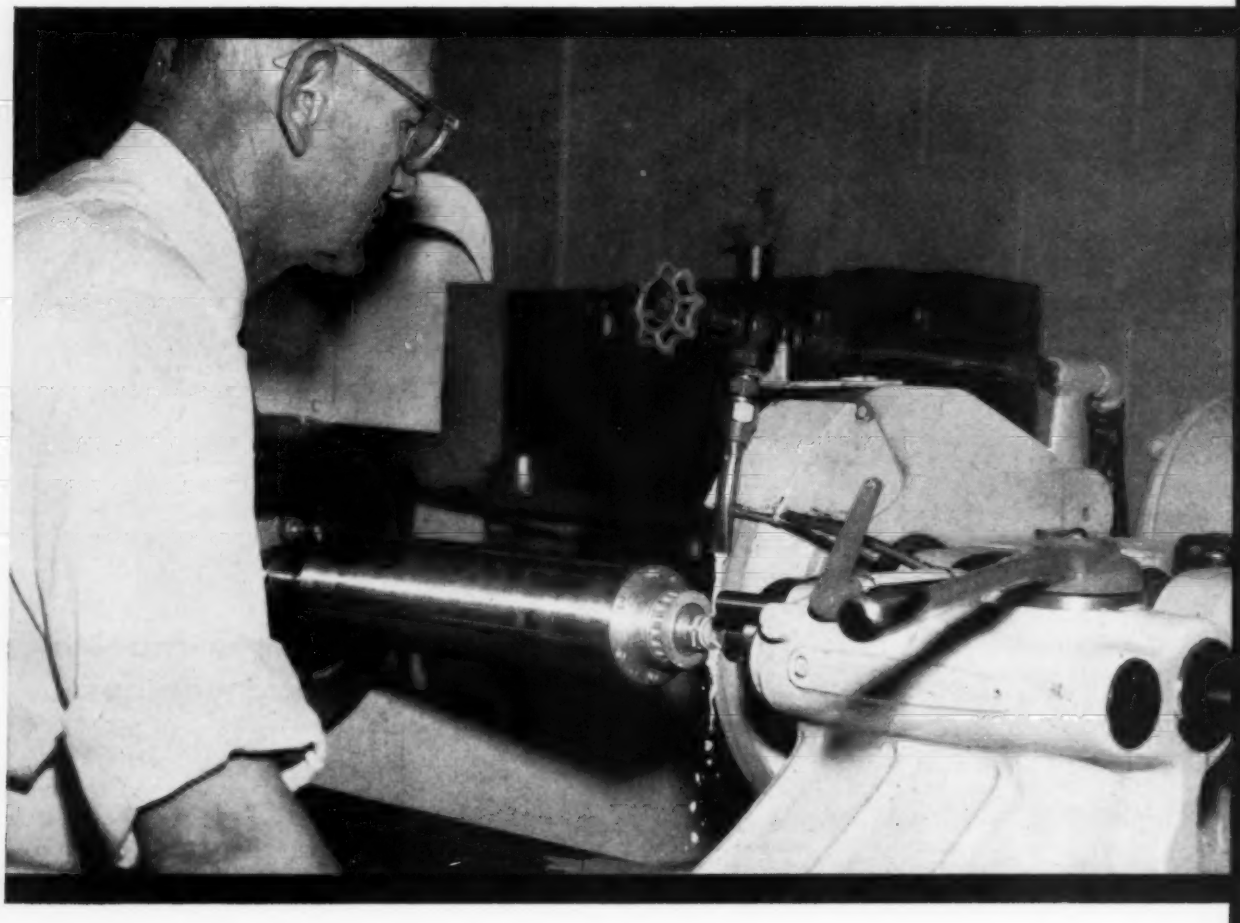
AT INTERNATIONAL BUSINESS MACHINES

Stuart **CODOL**

LIQUID GRINDING COMPOUND



CODOL stays clean, keeps wheels clean!

In line with a policy of carefully selecting the right grinding compound for each operation, the Endicott IBM plant uses Stuart's Codol for parts on which fine finishes are required.

Bud Ingram, in charge of the Magnetic Drum Rotor Department says this, "We cannot afford the so-called margin for error. Any dirt, any scratch on the surface, will affect performance of the 'memory unit.' That's one of the main reasons we use Codol—it's clean when we get it, and it doesn't pick up foreign particles."

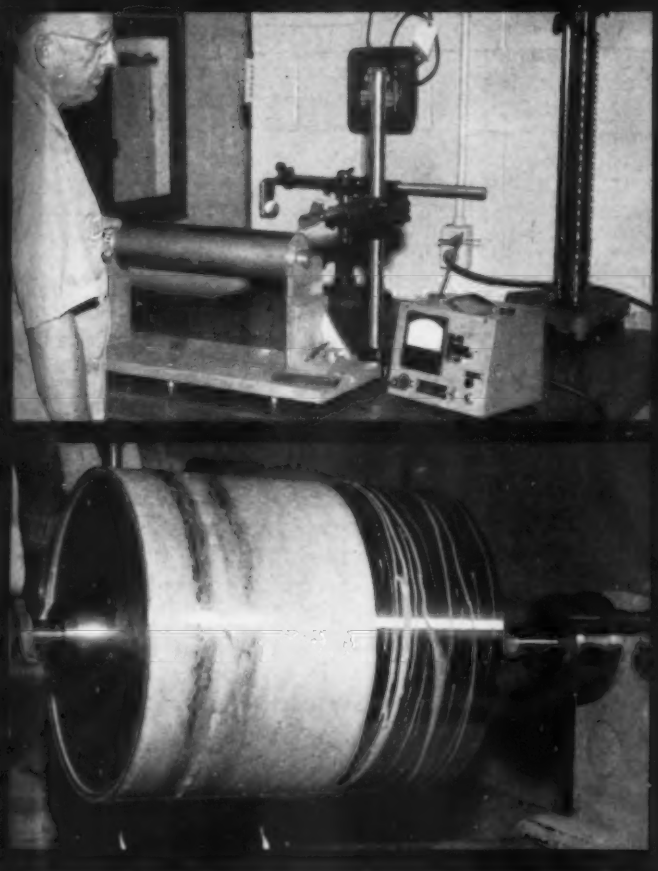
Codol's high detergency, lubricity, cooling, and rust-inhibiting characteristics win enthusiasm wherever it is used. A specially formulated semi-colloidal compound of petroleum oil and chemical emulsifier, Codol features perfectly balanced surface tension, floats chips away from the wheel, work, and machine, permits faster stock removal in roughing operations, closer tolerances in fine finishing. *Codol lubricates as it cools*—eliminates wheel-loading and protects work from metal flow, heat-caused stress failure, and loss of dimensional control through heat distortion.

Of the many grinding processes going into the production of IBM's data processing or "memory" machines at Endicott, New York, about a dozen stand out as critical. And for practically all of these fine-tolerance operations, Stuart's Codol Liquid Grinding Compound is used.

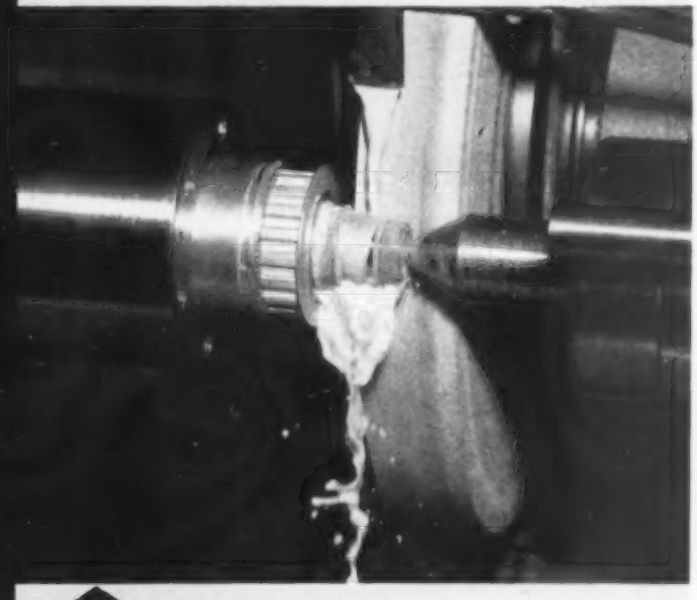
Processing and finishing of the IBM machine's all-important "memory unit" shown below dramatically illustrates the tough grinding problems and excellent results with Codol. The Magnetic Drum Rotor, a drum of monel coated with copper, is finally plated with colbalt-nickel to an outside diameter of four inches. In operation of the machine this outside coating retains and categorizes all the information introduced into the circuits. *Any dirt, scratch, or dimensional inaccuracy on this surface can cause serious errors.*

Each surface from the monel through the cobalt-nickel stages is precision-finished on a No. 3 Brown & Sharpe Universal Grinder under a free flow of Stuart's Codol. About .008 in. is removed in each step, and concentricity must be held within .00025 in.

The extreme cleanliness of Codol is considered more important than its cooling efficiency in these critical grinding steps, but it excels in both. Carefully balanced surface tension floats grinding "chips" away from the work and prevents scratches. Extra lubricity aids chip formation and assures free-cutting action required for stress-free grinding.



OD concentricity of the four-inch "memory drum," measured with an electronic height gage, must be within .00025 in. after two plating and three grinding steps.



Finish-grinding of the drum bearing surface is done under a free flow of clean, efficient Codol Liquid Grinding Compound.

"For the smooth finish we need, Codol gives us the results," says engineer Jack Sedlak. The 10-inch drum here being finish-ground is for IBM's larger computer.

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Arrange now to test Stuart's Codol Liquid Grinding Compound on your difficult grinding operations.

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Industry Observer

• *New orders to manufacturers* are rising from their second-quarter lows. The upsurge indicates many "wait and see" potential machine tool buyers decided to at least make partial commitments for their requirements. Net new orders of metal cutting type machine tools were up to $55,850,000 in July—an increase of 30% over June—and the highest level reached in the previous four months. Shipments dropped to $58,500,000, leaving the backlog of 4.2 months. Cancellations were the lowest in 21 months. For the four quarters ahead, machinery makers are forecasting a 12% increase in dollar volume of new orders, as compared with the past four quarters. In the metals market, the buyer will be favored. This time last year prices were skyrocketing and supplies were short. Now supplies are ample and capacity is still growing. But demand for steel is edging up. Operating rates for the fourth quarter should average about 88% of capacity. Third quarter rate was 83%. Heavy steel products such as plates, structural shapes and oil country pipe continue to be most in demand. Total business inventories are setting new records, but are still not out of line in relation to sales. The bulk of their buildup is accounted for by price hikes. The real rise in stocks has been only 20% as great this year as in the same period of '56. Neither substantial over-all liquidation nor accumulation is in sight, so inventory policies are not likely to stimulate or slow down business for the balance of the year.

The Lockheed Missile Systems Division research and development laboratories at Palo Alto, Calif., recently announced the operation of a huge new shock tube to test ballistic missile designs at speeds of 13,000 miles an hour.

The 40-foot-long tube, custom built to Lockheed specifications produces shock waves which travel 17 times the speed of sound. This shock tube is being used for advanced design work on the Navy Polaris ballistic missile.

Dr. Daniel Bershader, head of the missile divisions gas dynamics department said that temperatures and pressures generated within the shock tube will simulate those encountered by a long range ballistic missile as it plunges from space into the earth's dense blanket of air.

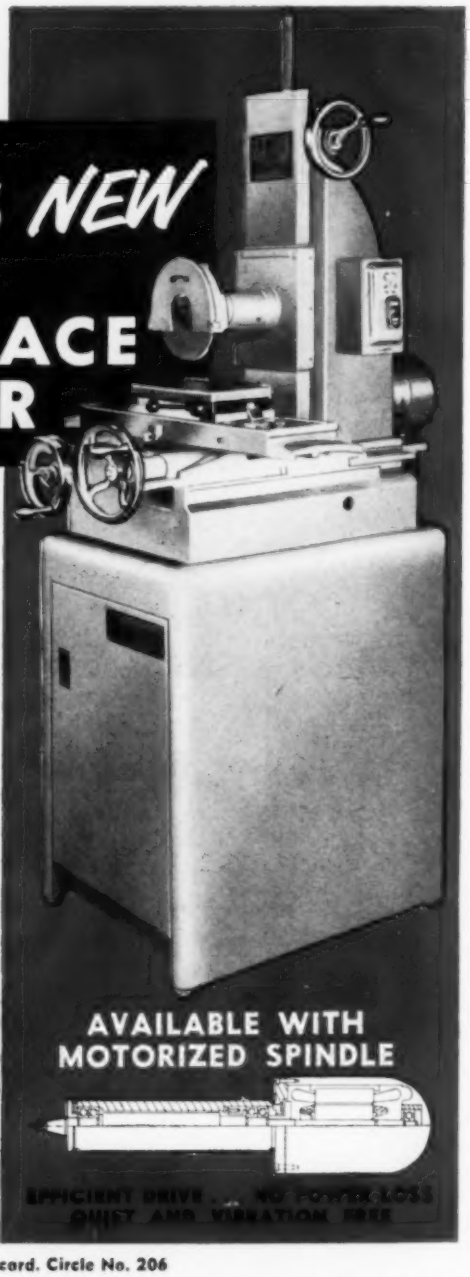
Lockheed scientists will study heat transfer, shock wave shapes and other details of airflow around missile models. In addition they will perform basic research in high temperature gas dynamics.

The shock tube works on the build-up of gas under pressure at one end of the tube which ruptures a thin diaphram when the pressure reaches a certain level. The high pressure gas then speeds down the tube behind a hypersonic shock wave.

The Lockheed shock tube, made of stainless steel, has an inside diameter of three inches and walls an inch and a half thick. At the end of the tube is an 18-inch-diameter, three-foot-long "dump chamber" which absorbs the shock wave in order to avoid excessive pressures by reflection.

Performance Plus!

Harig's NEW 6 x 12 TML SURFACE GRINDER



The new TML by Harig provides extremely fast and accurate grinding, with a new operational ease never before known. 100% more longitudinal travel than before with each rotation of the wheel. You get smooth surfaces in minimum time. Economical—low maintenance.

SPECIFICATIONS

Longitudinal travel.....12¾"
Transverse travel.....7"
Vertical travel.....12¾"
Working surface of platen.....6" x 12"
½" T slot
Grinding wheel.....7" dia. x ½" face
Grinds 12¾" over platen with 7" wheel
Standard spindle speed 3000 R.P.M.
½ or ¾ H.P. motor—Net wt. with motor 575 lbs.
Can be used with or without floor stand.

Harig Manufacturing Corp

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Improve Your Metal Finishing ...at LOW Cost

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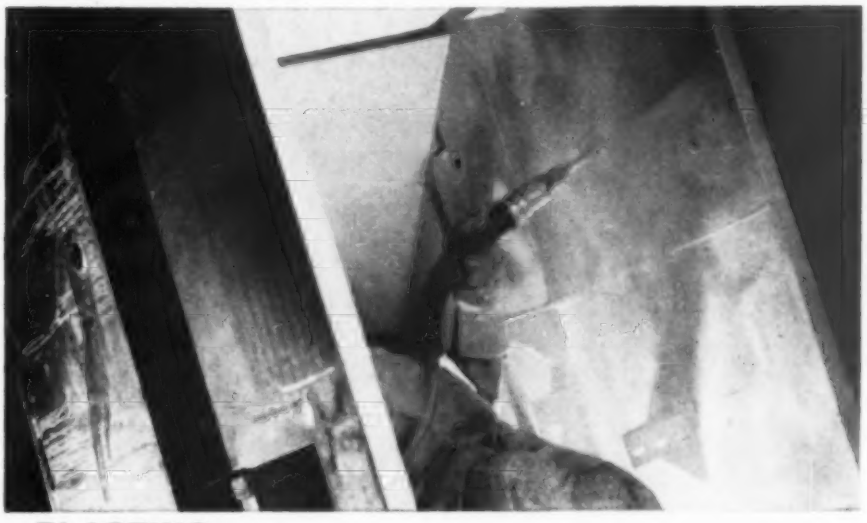

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BARREL FINISHING

The Carborundum Company makes available one of the world's widest assortments of grains, powders and tumbling media developed expressly for surface finishing operations throughout industry.

The abrasive grains manufactured by The Carborundum Company are unexcelled for their uniformity of strength, shape and size. The production facilities, the grading and inspection operations and the chemical and physical controls over all phases of the manufacturing process assure three-fold uniformity in shipment after shipment.

Call your CARBORUNDUM distributor or salesman

for expert counsel on your particular problem. Or, write Electro Minerals Division, Niagara Falls, New York.

Ask the Man from **CARBORUNDUM**
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ALSO makers of a complete line of Coated and Bonded Abrasives

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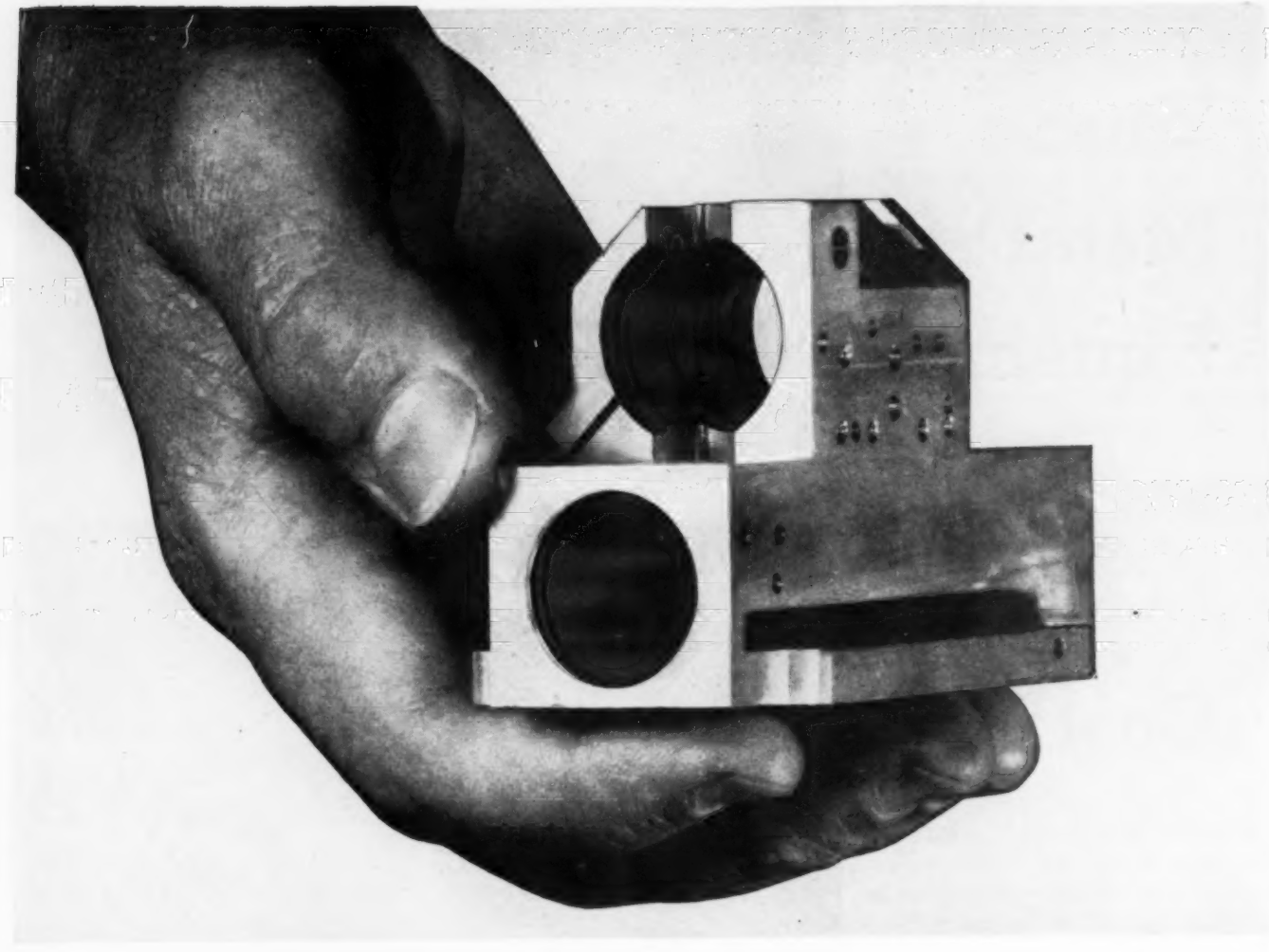
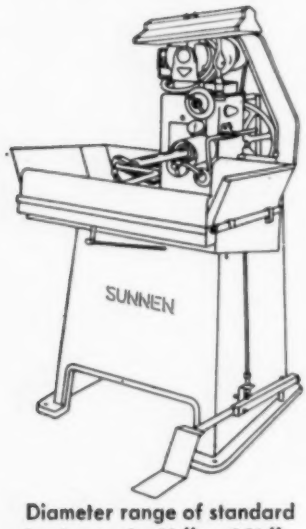


NO ROOM FOR ERROR IN THIS $300 PART!



Diameter range of standard honing tools: ⅛" to 2⅝".

This aluminum servo-valve body represents an investment of nearly $300 before the two large holes are sized and finished. With so much at stake, you can't afford any hole machining error that would put the part on the scrap pile!

The method which proved reliable enough to assure the required precision was Sunnen Honing. It guaranteed the specified tolerances of .0005" and .0002" . . . with 16 and 8 micro-inch finish for the respective holes. Sunnen Honing also guarantees geometric roundness and straightness . . . with controlled stock removal from thousandths to split-tenths as desired.

Your hole job may not be this critical, but Sunnen Honing can help you, too—on production runs, job lots and salvage. Your capital investment and cost per piece are surprisingly low. Average honing machine installation with tooling runs about $1,000. Why not write us about your problem?

send for five informative

honing booklets

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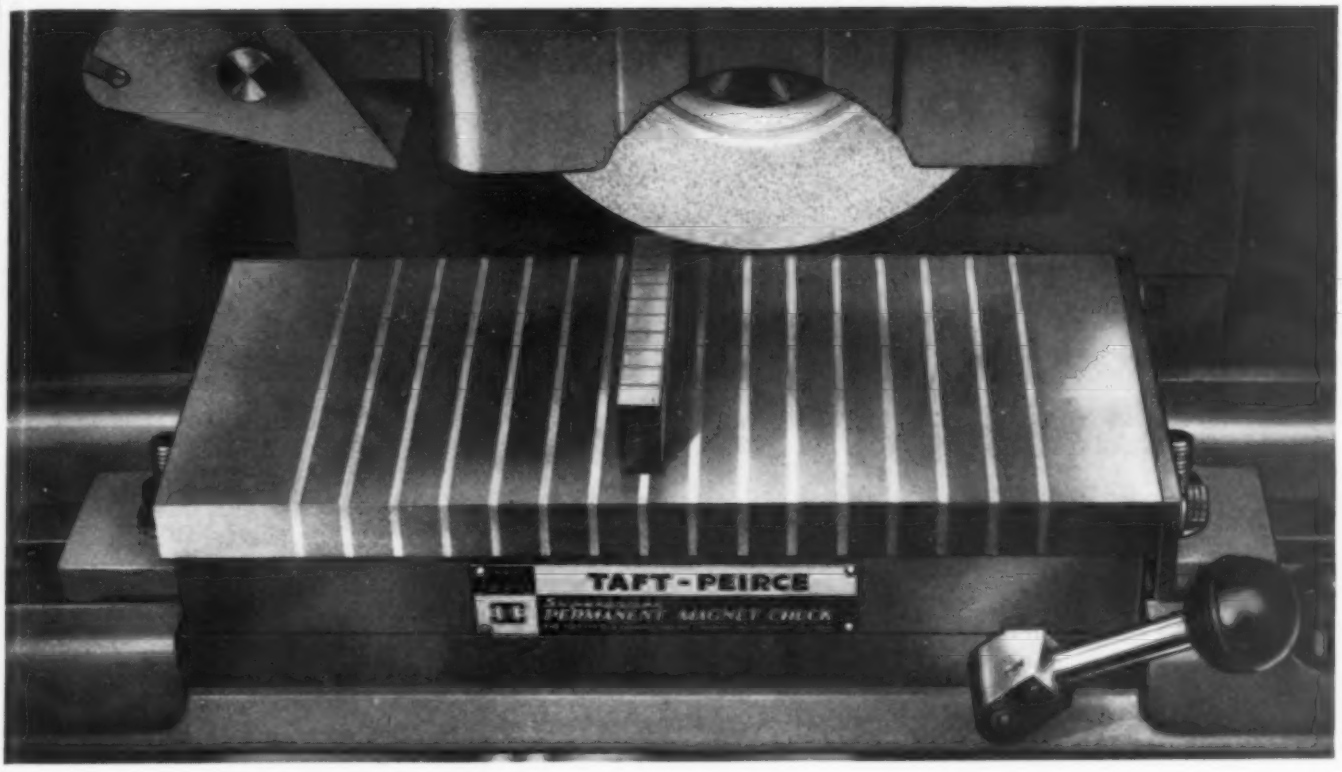
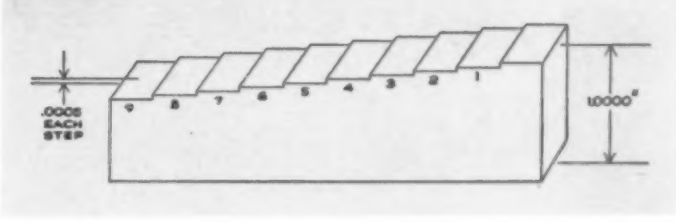


New Step-Block Test Shows .000012" Downfeed Accuracy on Taft-Peirce No. 1 Grinder



This is the Taft-Peirce No. 1 Precision Surface Grinder. It offers the exclusive tilting wheelhead plus a selection of seventeen different attachments for all-purpose application. Operators easily grind to .0001", and to .00005" with experience. Surfaces are so smooth they seal without lapping.

Gagemaker tolerances easily produced with exclusive T-P Vernier Fine-Feed — for tool room or small parts production.

Tests of grinding accuracy on a Taft-Peirce No. 1 Grinder constantly prove the remarkable accuracy of this machine. The latest — a step-block demonstration — shows just what tolerances you can expect.

A four inch long block was ground to a height of 1.0000", then nine consecutive steps in depth increments of .0005" were ground, using the Vernier Fine-Feed. Result: Inspection of height at each step revealed an average error of only .000012"! A T-P Versachek Electronic Gage with 4000:1 magnification was used for inspection.

This remarkable downfeed accuracy offers superlative results for tool, die, and gage work; as well as for small parts production. Plan now to add this all-purpose precision grinder to your facilities — send for Data Sheet MT-001 and Catalog.

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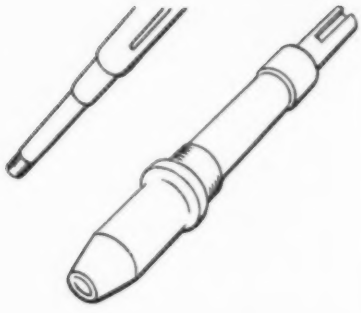

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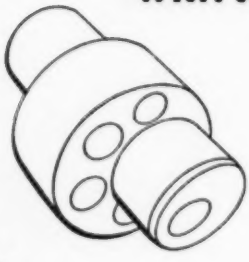
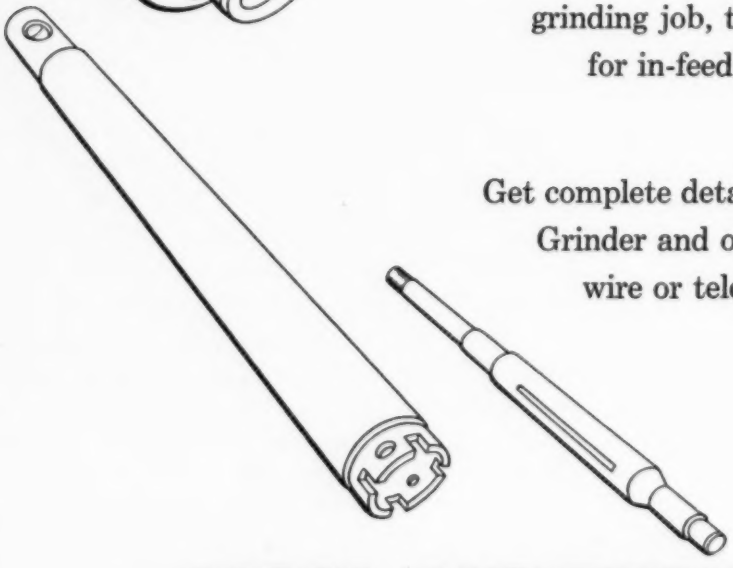


This rugged Van Norman 2C centerless actually gives you the workability of three centerless grinders with a minimum of changeover time. Featuring a 15 HP main drive motor which gives you enough HP for every grinding job, the 2C is equipped for thru-feed work, for in-feed and, with crush dressing attachment, form grinding and profile work.

Get complete details on the Van Norman 2C Centerless Grinder and on other Van Norman grinders. Write, wire or telephone today for descriptive catalogs.



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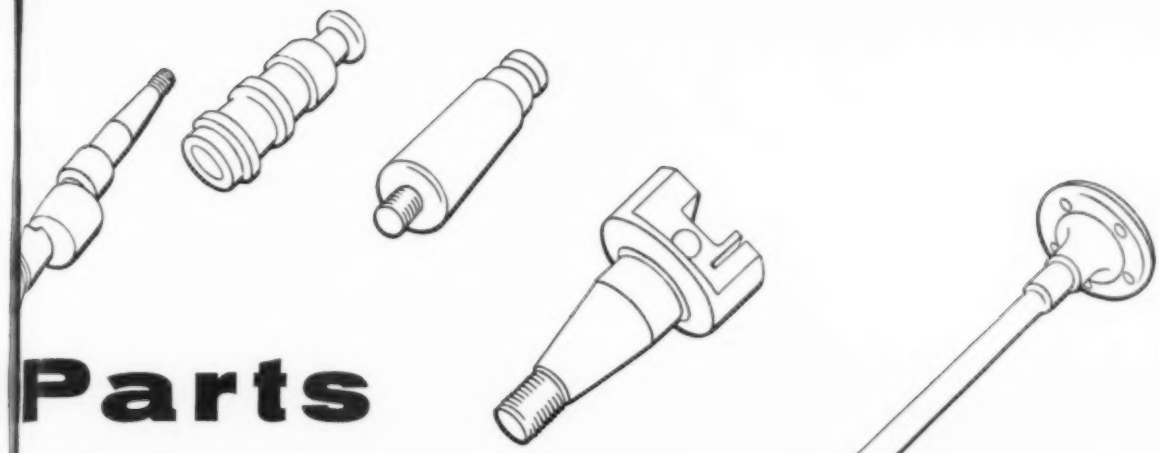
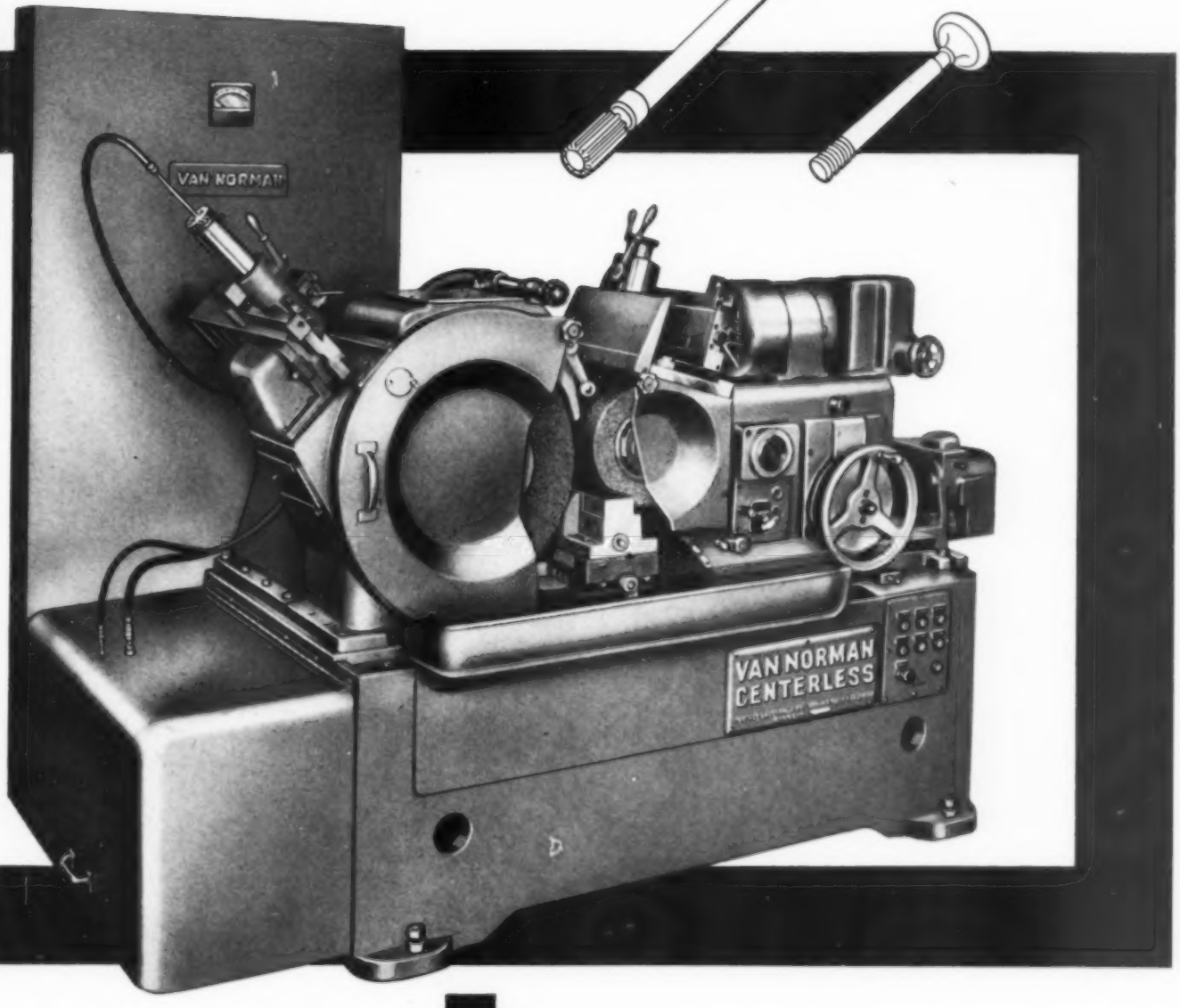


Parts



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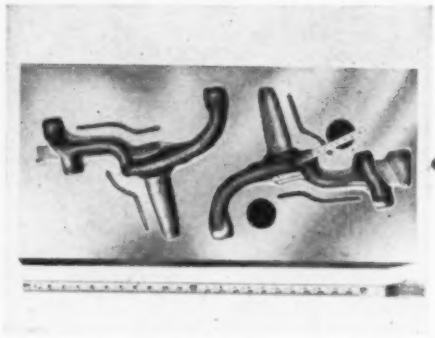
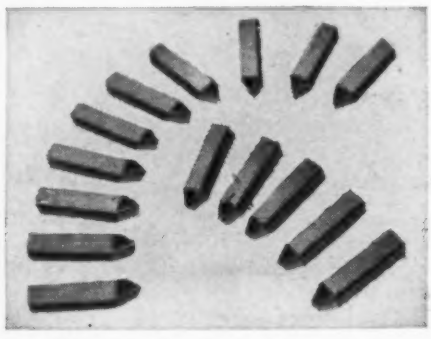
FORGING DIE INSERT

Material: Heppenstall 'A'
Conventional Machining
Time: 76 hours
Elox Setup & Machining
Time: 45 hours
Saved: 31 hours
Machine tool: Elox M-501 DieMatic
Electrode: Cast Elo-met
Customers report 50% saving on new forging dies and 75% savings in reworking dies.



TUNGSTEN CARBIDE SINGLE POINT TOOLS

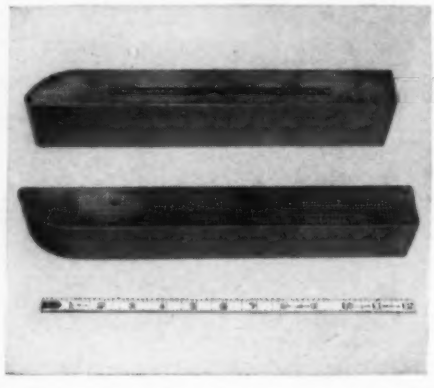
E D M produces 14 identically machined tools per hour. Times include roughing and finishing, machining both faces, nose radius and top. Radius held to ± .001". Tools were produced by 1 man operating 2 Elox Tool & Cutter Grinders, using a brass wheel. Users report Elox ground tools give greatly increased life when compared to abrasive ground tools.



EMBOSSING DIE

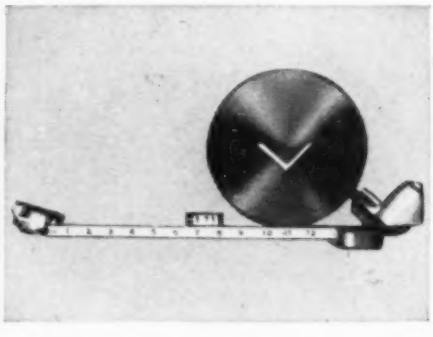
Material: Air Hardened Tool Steel
Die consists of 1,250 squares machined .100" x .030" deep in the bottom section of the die. Sharp corners on each square had to be maintained.

Conventional Machining
Time: 227 hours
Elox Setup & Machining
Time: 10 hours
Saved: 217 hours
Machine Tool: Elox Standard M-500
Electrode: Free machining brass



EXTRUSION DIE

Material: Air Hardened Tool Steel
Conventional
Machining Time: 4 hours
Elox Setup &
Machining Time: 1 hr. 38 min.
Saved: 2 Hrs. 22 min.
Machine Tool: Elox Standard M-500
Electrode: Free machining brass
Machining is done after final heat treating . . . eliminating the possibility of distortion.



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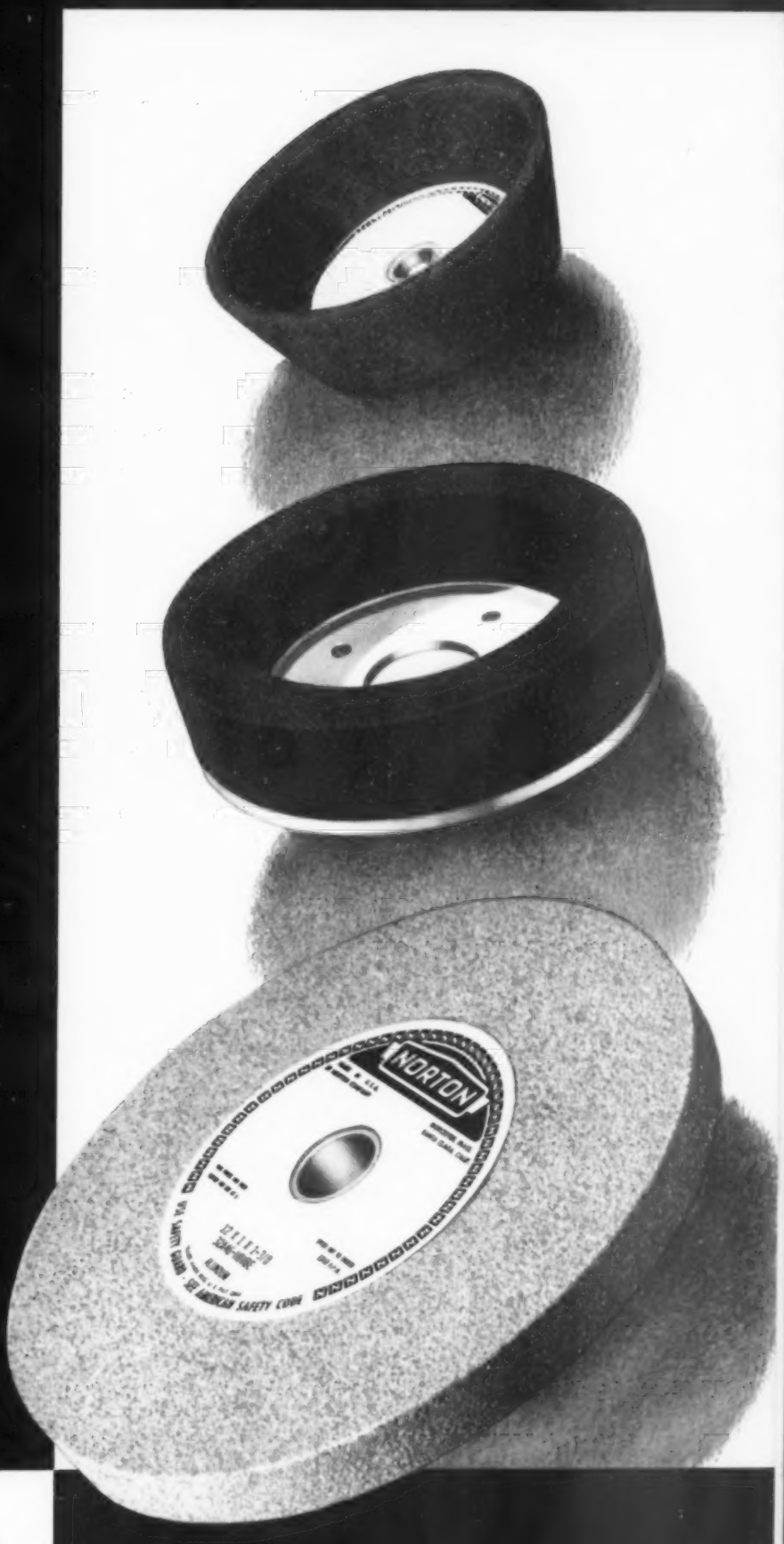

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5-57

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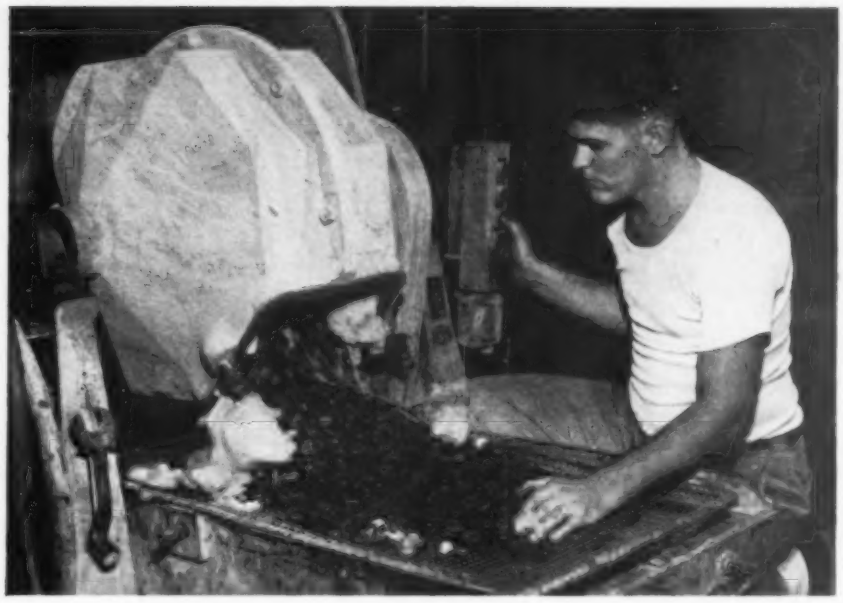

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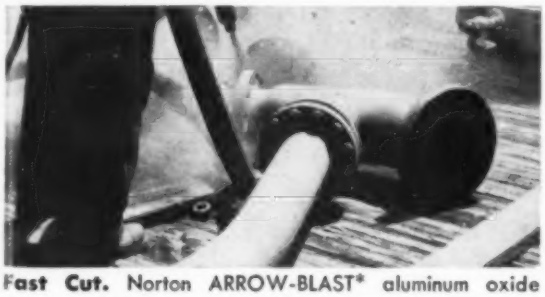

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Grinding and Finishing

Editor's Page

The Mighty Microinch!

There is something wondrous and soul-satisfying about technological advancement and scientific progress. As quickly as one manufacturer says, "I can now do so-and-so," everyone clamors to take advantage of the development. We're thinking primarily in terms of dimensional tolerances and surface finishes.

When it became known, years ago, that some machine tools were holding accuracy to one thousandths designers and engineers specified everything to this new dimension. And with splendid results. The same thing occurred when one ten thousandth no longer held terrors for the manufacturer.

Now designers and engineers have discovered the microinch!

Hah, here's a wondrous world of millionths! Fantastic what the abrasive industry can do; simply phenomenal. Let's design something in millionths.

And they do; everything from projecticles to gas pipes that are buried in the ground is specified to 1 microinch. No manufacturer has an objection to working to close tolerances, providing someone will pay the cost, but it does seem a bit silly, sometimes, to work to 1 microinch when there's no need for it.

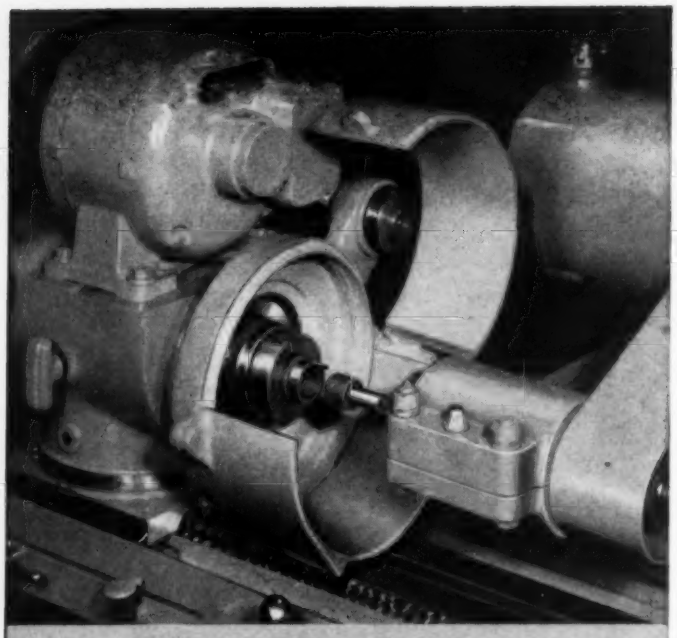
We spent some time recently with a manufacturer who had an ordnance order for cams with a surface specification of 30 microinches on the sides of the cam; the edges, which needed it, were not specified at all. The cam was a pretty expensive item to produce, requiring lapping on two sides.

We've seen prints for projectiles, which at best, would find an explosive demise, specifying surface finishes of 40 microinches on the base. Remembering our own experiences with anti-tank shot production during the war, we continue to shake our head over a greate waste of time and effort.

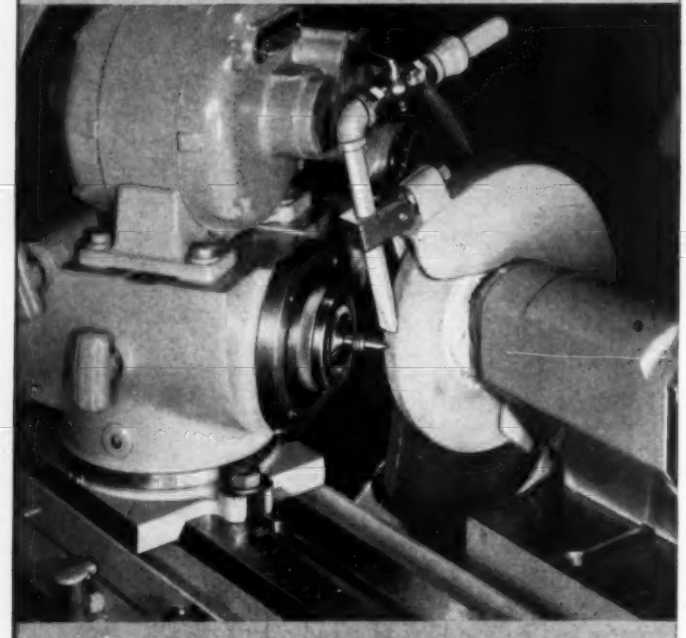
If designers would use caution and discretion and indicate an exact finish where it's absolutely required considerable money could be saved. The irreverent specifying of microinch dimensions is ridiculous and unnecessary. To be sure, the abrasive industry can do it neatly, but no one likes to spend a lot of time over an unnecessary job.

Remember to figure the cost: if 2000 microinches has a cost rating of 1 then a Fine finish (63 microinches) has a cost rating of 13; a Ground finish (16 microinches), a rating of 25; Polish (8 microinches), a rating of 35; and Super Finish (4 microinches), a rating of 40. It becomes evident that there is a point of diminishing returns if surface finishes are specified indiscriminately. Specify them by all means, if needed, but don't do it for the fun of it. It becomes costly.

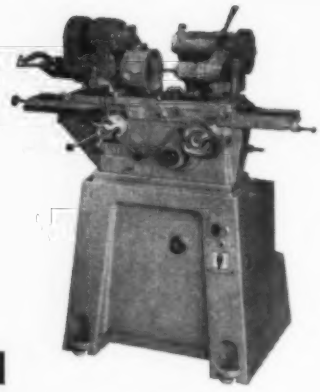
Wm. J. Schleicher



Grinding a straight hole with the work held in a step chuck.



Grinding sharp taper on metering needle held in collet with workhead swiveled 30°.



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Grinding and Finishing
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• matched components and

• controlled wear result in

Better Reinforced Cut-off Wheels

by **Dr. H. Nathan Stone,**
Asst. Dir. of Research and Development
Bay State Abrasive Products Co.
Westboro, Mass.

The results of recent research indicate that cut-off wheel life can be prolonged an average of 33% simply by careful matching of components and by certain improvements in the manufacturing process.

Small differences in the composition of a cut-off wheel can result in wide differences in wheel performance.

A reinforced cut-off wheel is a complex body which must incorporate the strength and safety provided by reinforcement and still preserve the primary function of cutting freely.

The solution to the problem of building an effective reinforced cut-off wheel involves more than the selection of the individual ingredients.

• A theoretically perfect cut-off wheel would behave as though its three principal components had *grown* together to form a single, homogeneous unit. Bond and reinforcement would wear away at a uniform rate and that rate would be precisely determined by the rate at which the abrasive grain wore.

This would result in a cutting wheel of maximum efficiency and maximum economy in which not the slightest particle of grain, bond or reinforcement would be wasted.

While theoretical perfection may be a distant goal at the present time, better control of component wear rates is possible. The results of recent research indicate, in fact, that cut-off wheel life can be prolonged an average of 33% simply by careful matching of components and by certain improvements in the manufacturing process.

Before going into detail on the results achieved, however, it may be worth while to review the principles of abrasive cutting.

It is a fact that metal cutting is one of the most rigorous uses to which abrasives can be put. Recommended peripheral speeds for cutting-off operations range between 11,000 and 16,000 surface feet per minute. At this rate an abrasive grain on the cutting edge is entering the work piece at about 180 miles per hour. In contrast, normal precision grinding utilizes speeds of 6,000 surface feet per minute. Even snagging operations do not utilize speeds in excess of 9500 surface feet per minute.

The extreme speeds in cutting-off naturally result in extreme impact and shock on the cutting particles. Pressures at the point of contact also exceed those encountered in other grinding operations. Cut-off wheels are normally ⅛" to ¼" thick and all of the infeed force must be transmitted through these narrow cross sections. Furthermore, higher speeds and

pressures generate comparably higher temperature in the area of the abrasive action.

Under these conditions small differences in the composition of a cut-off wheel can result in wide differences in wheel performance. Herein lies great opportunity for abrasive cut-off wheel manufacturers to provide their customers with substantial improvement.

The forces involved in cut-off work can be translated into efficient cutting if the machine is able to maintain its speed during the cutting operations. Machinery manufacturers have demonstrated their awareness of this fact by increasing the horsepower of their equipment. As they do this it continues to provide further opportunities and responsibilities for abrasive wheel manufacturers to develop cut-off wheels which will take greater advantage of the improved horsepower to cut faster and last longer.

The toughest kind of cut-off work exists in the foundry. Much of the cutting must be done off-hand and this results in a lack of rigid control over the work piece or the cutting wheel. These conditions have brought about the development of fabric reinforced cut-off wheels which will resist the radial and transverse stresses produced by the speed of rotation and lateral pressures brought about by off-hand cutting.

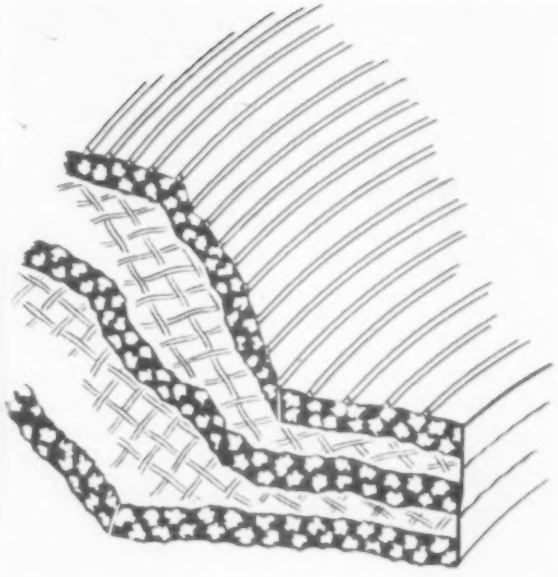
Thus, a reinforced cut-off wheel is a complex body which must incorporate the strength and safety provided by reinforcement and still preserve the primary function of cutting freely. In the unreinforced wheel the problem of matching the bond to the abrasive is essentially a problem of finding a bond that will hold onto the abrasive grain as long as it remains sharp and cuts efficiently. However, in a reinforced wheel the situation is complicated by the addition of the reinforcement. The abrasive, reinforcement, and bond form a three component system within which each component interacts with the other two producing an individual and collective effect. The bond must retain its firm hold on the abrasive grain; however, the reinforcing material has a profound effect on the rate at which the bond wears away and thus affects its holding power on the grain. The reinforcement must accomplish its function of increasing the wheel's resistance to radial and transverse stresses but at the same time it must not interfere with the cutting performance of the wheel. It must wear away at the same rate as the bond and not smear or smoke in doing so. In a successful wheel this is accomplished by matching the components to one another and producing controlled wear.

Before the performance of a reinforced cut-off wheel as a unit is discussed, the function performed by the individual components should be examined. As indicated above, the reinforcement serves to increase the wheel's resistance to the new type of stresses imposed by foundry cutting-off work. The mere presence of reinforcing material does not insure this result. What is desired is effective stress distribution and this depends upon an intimate bonding between the reinforcement and the resin. Under these conditions localized forces can be distributed over a larger area and their damaging effect is minimized.

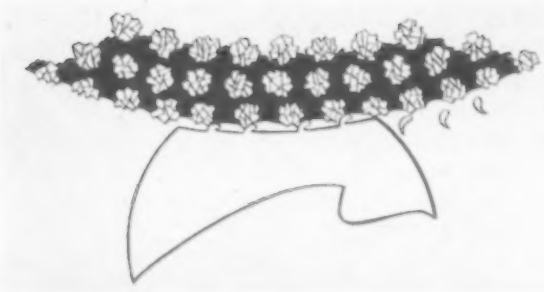
The abrasive grains are the actual cutting tools and the bond is the mechanism by which the abrasive and reinforcement are held in the shape of a wheel. The bond and the reinforcement together comprise a type of tool holder which must wear away at the correct rate. This tool holder is unique in that it must not only serve to bring the abrasive to the work; it must provide an atmosphere both chemically and physically conducive to effective metal removal.

As a cutting tool, each abrasive grain must remove tiny chips of metal from the work piece. For effective chip formation, the abrasive must remain sharp, and this

THIS 24-IN. FOX SWING-FRAME CUT-OFF MACHINE is powered by a 25 h.p. motor. The trend is to more power to maintain maximum wheel speed for greater efficiency. As this happens it opens the way to better cut-off wheels.



THE TYPICAL FOUNDRY CUT-OFF WHEEL comprises a three component system. Abrasive grain, bond and reinforcing material must be matched to work as a unit for effective performance. If bond between resin and reinforcing material is not intimate, then this interface will be a surface of weakness and excessive mechanical breakdown will occur.



AT CUT-OFF WHEEL'S PERIPHERY IS ABRASIVE GRAIN surrounded by bond. During operation erosive wear dulls grain while bond-line recedes to expose more of each until forces imposed on the grain cause them to fracture. These fractures produce the sharp cutting edges necessary for fast cutting. Rate at which bond wears must be matched to wearing and fracturing behavior of the grain.

ABRASIVE GRAIN ON THE CUTTING EDGE enters the work piece at 180 miles per hour. The impact pressures and temperatures are extreme. Under these conditions better matching of the wheel's components so they work more efficiently together makes important improvements in performance.

is achieved by repeated fractures of the abrasive grain under the impact of the cutting action. These fractures leave sharp angular faces exposed. It is a basic consideration that the size of the pieces lost in each of these fractures be controlled. The optimum rate at which this fragmentation wear must occur is largely dependent upon an undesirable erosive type of wear, which is both chemical and physical in nature, and which results from interaction at the interface of the abrasive crystal and the metal being cut. The extreme temperatures produced at this boundary make this interaction significant. It exhibits itself in the form of abrasive grains which have had the sharp corners eroded away or in the form of grains which have been wetted and smeared by the metal. Either phenomenon reduces the cutting rate.

The solution to the problems outlined above involves the selection of components that are matched to one another in such a way as to produce a balanced rate of wear. Since the reinforcement and bond have been referred to as a form of tool holder, they must necessarily wear away at a rate which is optimum for the abrasive involved. In the sketches presented, schematic illustrations of a small section of the periphery of an abrasive cut-

off wheel and its internal construction are shown. As can be seen the periphery is composed of abrasive grain surrounded by bond. As the bond recedes during operation, it exposes each abrasive grain to a point where the forces imposed upon it by its penetration into the metal overcome the shear strength of the abrasive grain and fracture occurs. These fractures produce the sharp cutting edges which are necessary for efficient operation.

If the bond and reinforcement abrade away too easily, the grain becomes exposed too rapidly and as a result, the pieces fractured away become too large and the abrasive grains are pulled from their sockets prematurely. The rate at which this bond line recedes is controlled by several factors. In the absence of reinforcement, the wearing away of the bond would result primarily from mechanical abrasion and thermal degradation. In other words, if the physical properties of the bond are such that its resistance to abrasion is poor or if the bond has a tendency to soften and deteriorate rapidly at high temperatures, the grain will be lost prematurely. In the presence of a reinforcing material, the interface between the reinforcement and the bonding resin tends to help control the rate at which the bond wears away. If there is not an intimate bond between the bonding resin and the reinforcing material, then this interface will be a surface of weakness and excessive mechanical breakdown will occur, upsetting the balance of the wear rates. As stated previously, the reinforcing material must also wear away at the same rate as the bond so that no loose ends are left protruding from the face of the wheel.

There is also a possibility that the bond line may recede too slowly. In this event, the fragmentation wear of the abrasive is slowed down and the erosive wear which tends to produce rounded edges and interaction between the abrasive grain and the metal becomes predominant. These effects are minimized by building into the wheel a balance in the wear rates of the various components. The bond can perform still another function in eliminating these detrimental effects. If the ingredients of the bond are selected carefully, they can be made to produce, as they decompose, materials that serve to prevent the undesirable interaction between the abrasive and the metal being cut.

So, the solution to the problem of building an effective reinforced cut-off wheel involves more than the selection of the individual ingredients. It requires forming a combination that functions as a unit. This can be clearly demonstrated by the comparison of two sets of wheels, both of which contain only materials which individually are beneficial to the performance of a reinforced cut-off wheel. However, in one case a greater refinement has been achieved in matching the ingredients to obtain balanced wear rates. Both wheels proved effective in the roles for which they were designed. The Saf-T-Cut BZ2 wheel is a reinforced cut-off wheel which has been widely accepted and used in foundry work for several years but is being replaced by a newly developed wheel designated as Saf-T-Cut BZ2AA. The latter is the same type and contains many of the same ingredients, but a closer matching of these ingredients has been achieved. The data in Table I and II demonstrates how an extra margin of efficiency can be obtained by the process of more closely matching the ingredients. The differences are subtle and unobservable in the finished product, but in performance they mean real and healthy savings in the foundry's cleaning room. • • •

TABLE I

CUTTING PERFORMANCE OF BZ2 VS. BZ2AA

Cold rolled steel—1″ square

Campbell 213 Dry

Wheel Size—16 x ⅛ x 1

Wheel Type	Initial Diam. In.	Final Diam. In.	No. of Cuts	Efficiency
BZ-2	16.06	8.81	156	1.06
	16.06	9.00	157	1.13
	16.06	9.00	161	1.16
BZ-2AA	16.06	9.00	228	1.64
	16.06	9.00	193	1.39
	16.06	8.88	210	1.51

TABLE II

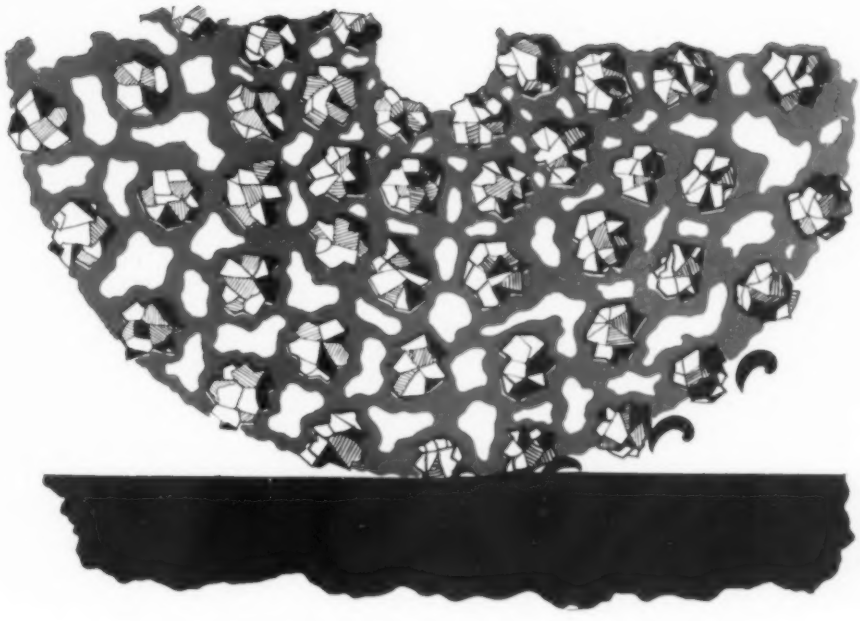
CUTTING PERFORMANCE BZ-2 VS. BZ-2AA

Cold Rolled Steel 1½″ round

Campbell 213 Dry

Wheel Size—16 x ⅛ x 1

Wheel Type	Initial Diam. In.	Final Diam. In.	No. of Cuts	Efficiency
BZ-2	16.06	9.19	58	.75
	16.06	8.94	57	.72
BZ-2AA	16.06	9.06	71	.91
	16.06	8.94	82	1.04



What is Variable or Progressive Density? It's . . .

Uniform Grinding Action As the Wheel Wears Down

The density of the grinding wheel varies to provide a gradual adjustment as the wheel wears to compensate for reduced sfpm and reduced arc of contact

By **Darrell Ward**
Field Editor

• We began hearing about "variable density," "graduated density" and "tapered structure" in grinding wheel action• a few years ago. It sounded as though the density of the grains varied from wheel to wheel; but this is not what it is at all. "Variable density" really means that there is an increasing concentration of abrasive grains and bond as you go from the periphery of the wheel toward the center. The purpose is to maintain a uniform cutting action as the wheel wears down, by putting a greater number of cutting points to work. Thus, one function of the variable density wheel is to counteract the effect of decreasing surface speed. Another effect which the variable density wheel counteracts is that of a reduced arc of contact between grinding wheel and work as the wheel wears.

You can see that a gradual increase in density of grits and bond to voids is not the same as the wheel made with a definite line of demarcation at some point of the diameter. There are several companies making both types of these wheels. This company's manager of sales engineering describes the two types as follows:

"A wheel of two separate grades with a definite line of demarcation is employed in a situation where the wheel is initially used on one machine and subsequently dismounted at a certain diameter and mounted for further use on another machine where the grade requirement differs from the first machine.

"A 'graduated density' wheel is one which is used on a single machine and the gradually increased density is utilized in order to compensate for the gradual decrease in wheel grade resulting from the decrease in peripheral speed."

Of course, the loss in diameter during grinding operations could be compensated for by changes in work speed and infeed. However, we are discussing now the large diameter wheels used in cylindrical, centerless and surface grinding. The big machines that do this type of work do not have the variable speed feature.

Does the variable density type of grinding wheel make a more efficient, more effective tool? To find out about the number of pieces produced, dressing requirements, finish, corner holding and metal removal rate, you have to talk to grinding department foremen and the men who operate the grinding machines. And you want to know what the manufacturer had in mind when he started working on such a concept.

The history of developments in metalworking discloses that progress in the improvement of any tool or machine tool has been evolutionary rather than revolutionary. This has also been true with the story of progress in the improvement of bonded abrasive products. Progressive or variable density in large diameter grinding wheels outside of the steel mills has a history of about five years. Developments have not been phenomenal or the results fantastic. The results outlined here have resulted from improvement in grinding wheels through long hours of tedious research.

It must be emphasized that there is no easy formula for grinding economies. Every operation requires individual study and attention by a competent abrasive engineer. Some competent sales engineers specify progressive density only with the large thin wheels. Other engineers believe that precision grinding operations should be compensated for loss-of-diameter by changes in work speed and infeed.

However, excellent results have been obtained with progressive density by firms who do not have grinders equipped with the variable speed feature.

Another company, a manufacturer of grinding wheels with variable density, reminded us that this principle has been going on in steel mill roll grinding for some years. In the steel mill the normal size grinding wheel is 36 inches in diameter. It is in the wheels with large diameters that this principle becomes economical. Some manufacturer, for example, produce variable density grinding wheels from 16 to 36 inches in diameter.

The shops we visited who used wheels made with variable density were using them on operations that required wheels with considerable distance between the outside diameter and the flanges. And why did they want a wheel with increasing density of grits as the diameter grows smaller? Because the increasing density assures uniform grinding action and longer life as the wheel wears down.

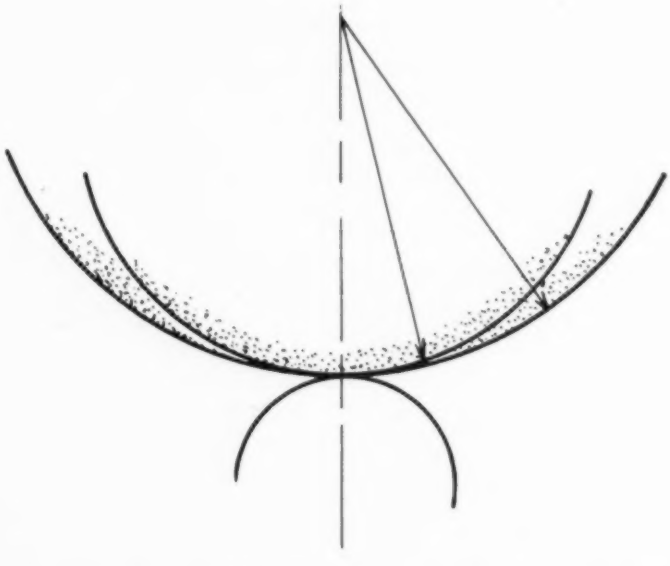
Here are the facts: A 20-inch wheel turning 1146 rpm is running at a rate of 6000 sfpm. When the wheel has worn to a 13-inch diameter, the same rpm will give only 3900 sfpm. Of course, a variable speed adjustment could maintain this 6000 sfpm. It does not compensate for the smaller arc of contact.

Some grinding department foremen have admitted that they had overlooked the importance of the change in the arc of contact. What must not be forgotten is that as the wheel gets smaller its contact with the work is decreasing. Because the smaller area has to bear the total pressure between wheel and work, the grains are torn out of the wheel sooner. And so, the wheel acts soft. Some manufacturers are given specifications to compensate for this; the result, however, is often a wheel with a definite line of demarcation between grades of hardness.

To make variable or progressive density practical in the sense that there is assurance of uniform grinding action and a controlled grinding surface, the wheel manufacturer must do some close figuring on the amount of change that takes place in the grinding operation. For instance, some wheels have a much larger hole in relation to the diameter than other wheels. Wheels come in varying thicknesses, some only 1-inch thick, others may be eight inches. Therefore, a series of ratios for an adjusted distribution must be worked out in relation to thickness of the wheel and size of hole in relation to diameter.

The traditional method of making grinding wheels is to pour the material in the mold and level with a straight blade to give you the same density of grits near the hole as near the outside periphery.

One of the arguments for variable density is that the wheel acts the same from the time it is first put on the machine until it wears out. Another argument is that inas-



COMPARISON between the arc of contact of a large wheel with that of the same wheel worn down to a smaller size. If increased rpm does not compensate for the smaller diameter the chip thickness of the smaller wheel will be greater. As contact with the work decreases as wheel gets smaller, the total pressure between work and wheel rises. Grains are torn out of the wheel sooner, unless there is compensation. Grinding wheels whose grains are graduated in density as the wheel wears down is a method of compensation to prevent the wheel from acting soft.

Manufacturers of grinding wheels use different terms to identify wheels discussed in this article. Some call them "variable density" others "progressive density" or "graduated density" or "tapered structure" wheels.

much as dressing takes man hours, the more dressing required, the more diamonds are used. The dressing operation, of course, takes more off the wheel than when you are grinding.

The manufacturing of grinding wheels with the variable or progressive density feature works out a series of ratios of grits and bond to voids. That is, whereas the orthodox method of manufacturing grinding wheels is to pour material in the mold and level with a straight blade and press to get the same concentration of material at the outside periphery as near the hole, with variable density the leveling blade is tilted, leaving a greater amount of material near the hole. Then, when pressure is applied from both sides with a straight plate, more material is pressed near the hole than the OD. According to the manufacturers and users, this processing method is uniform from wheel to wheel.

Observation in the shops that are using variable density wheels disclosed that it worked on snagging, rough or finish grinding. Incidentally, surface grinding with wheels 16 inches or larger is one of the most common applications for variable density wheels. And whereas an operator used to say "this was a good wheel when it was new, it is becoming softer than it used to be," what he was not recognizing was that the wheel was not becoming softer; its action became softer. Variable density wheels apparently changed all this.

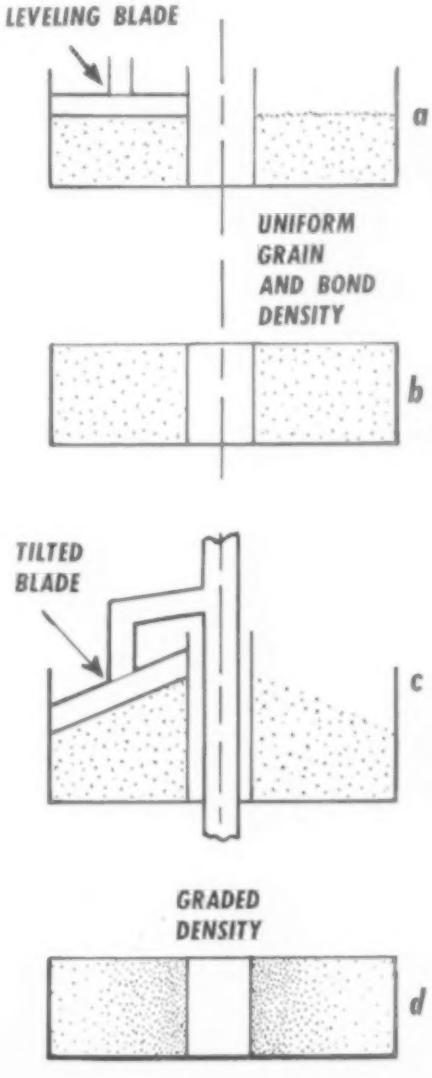
Some of the biggest problems in grinding today are the large cylindrical and centerless jobs. The grinding machines available for this type of operation are mostly of the type with a constant spindle speed. Engineers, fighting the battle of costs, wanted the wheel makers to do something that would eliminate the discarding of a wheel that still had lots of usable abrasive left. They wanted something that would compensate for loss of surface speed, which makes the wheel act softer, wear faster and cut slower.

The result has been a grinding wheel scientifically graduated in grade from periphery to hole. One of the pioneers of this type of progressive grade wheel produces wheels in the 20-inch diameter and larger size, using the gradient density construction whereby the progression of hardness increases gradually through the wheel from face to hole.

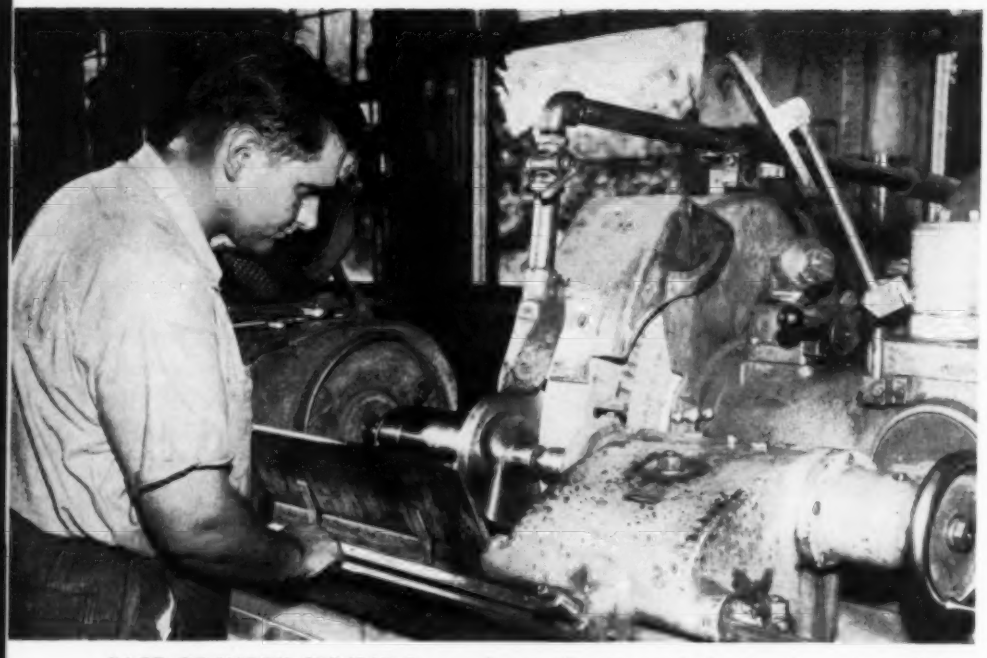
"It is our belief," says this company, "that the bulk of the wheels sold for constant speed machines should be manufactured in a gradually increasing scale of hardness, because it is natural when you consider that your surface feet per minute and contact area is reducing on a likewise graduated scale."

Producing wheels with a definite line of demarcation, of course, have their place. Perhaps what is required is that the wheel is to be transferred from one machine to another on a substantially more rugged operation. For example, in foundry operations where a wheel is transferred from a 30-inch floor stand to a 24-inch swing frame grinder, it would be advisable, if the nature of the workpiece on the swing grinder is substantially rougher on the wheel, that an increase in grade could be built into the wheel at the 24-inch diameter.

On the No. 2 centerless grinder that has a 20-inch wheel with a 12-inch hole, the decrease in radius down to the collar isn't particularly large and unless the shop is going into automatic grinding and dressing, this type of wheel doesn't have



In molding a conventional, uniform density grinding wheel, (a), the loose, unfired mixture of abrasive grain and bonding material is leveled in the mold with a straight blade before being compressed and fired (b). To make a wheel having an increasing density from the periphery to the hole, the blade is tilted (c) to level the grain-bond mixture high at the hole. Compression of the mixture by a flat ram then gives the graded density desired in the finished wheel (d).



FACE OF WORK SPINDLE for an Ingersoll cutter grinder is all set for grinding with variable density wheels at the Ingersoll Milling Machine Co. plant.

variable density. On the No. 3 centerless where the wheel has a 24-inch diameter and also a 12-inch hole, the operators report a noticeable change in grinding action.

CLOSEUP VIEW of the facing operation at Ingersoll.

Out at Ingersoll Milling Machine Company in Rockford, Ill. variable density wheels have been used for the past three years with the 18-, 20- and 30-inch wheel sizes (See illustrations). Foreman Walt Taylor said that they are successfully grinding the face and side of their shafts with the same wheel. Previously, when the uniform density wheels had worn down about four inches, they would begin to get soft and the finish was poor. There would be a 20-minute delay in changing the wheel. Tests with the variable density wheel proved it worked as hard when down five inches as when it was first tried; the cutting action was consistent throughout the life of the wheel.

Ingersoll, today, is using these wheels on hard and soft materials: brass, cast iron, tool steel and micarta. Piece parts ground include gears, spindles, bushings for bearing retainers, oil seal rings and shafts measuring up to 40 feet in length.

At the Sundstrand Aviation Division of Sundstrand Machine Tool Company, Rockford, Illinois, the cylindrical grinding of the roller race and the ball race on the pumps and motor cylinder blocks for the Boeing B-47 jet bomber's drive unit are done with variable density wheels. There are seven grinding operations on the I.D. and 18 grinding operations on the O.D. of the AISI 52100 steel forging.

Sundstrand Aviation engineers characterize variable density wheels as good all-purpose wheels. In fact, at this plant these wheels are used to cut anything from cast iron to brass. And whereas, under ordinary conditions this firm would order both 30" and 24" wheels, it was discovered that the 30-inch wheel was versatile enough to perform when down to 24 inches.

Marshall Steel Company of La Grange, Illinois, which produces numerous sizes of ground flat stock and ground drill rod, has a considerable investment in grinding machines and wheels. It is mighty important to this company that they get good free cutting action from their wheels. Dissatisfied with the 70 to 80 hour performance they were getting from wheels a few years ago, the management specified that wheels progress one grade harder toward the center. After a series of trials, the grinding department reported that it was getting up to 120 hours of good, free grinding with the variable density wheels.

As most of their production is in ground flat stock, surface grinding is the big operation here. Seventy per cent of the wheels used are 20 x 6 x 10. They also use 20 x 3 x 10 and 28 x 6 x 14 inch wheels.

With the successful introduction of continuous wheel forming (see Grinding and Finishing, May 1957), and the complete automation of form grinders just ahead, it appears that the variable density feature should fit right into this picture. If you get a uniform grinding action, you can do uniform automatic dressing.

If the dressing action is automatic, then obviously the tool with which you are dressing should automatically be adjusting itself to the grinding operation. At this point it appears that the two were made for each other.

However, care must be taken not to assume that variable density wheels are the answers to all grinding problems, they are not. As with all products, they have their place. Only the actual job to be done will determine which wheel, whether standard or variable density, is to be used. • • •

How to Get Greater Productivity From Abrasive Belts

by **S. L. Johnson,** Manager New Methods Dev. Section, Coated Abrasives and Related Products Div. Minnesota Mining & Mfg. Co. St. Paul, Minn.

- ✓ *avoid extreme pressures*
- ✓ *grit size and hardness of contact wheel is important*
- ✓ *softer wheels produce finer finish than harder contact wheels*
- ✓ *where heat will be generated use a Resinite or Resin bond*
- ✓ *operating speeds for belts are higher resulting in finer finish*
- ✓ *larger contact wheel produces lower RMS readings*
- ✓ *serrated or slotted wheel lengthens belt life*
- ✓ *angle of serration across face of contact wheel is important*

Many people are discovering for the first time the almost limitless variations of the product—and they are learning how to apply coated abrasives more economically than ever before. Secondly, if coated abrasives are versatile in their application, there is certainly versatility in product design—bondings, backings, minerals, coating and curing techniques, splices, and built-in and active chemicals that minimize premature galling and dulling.

I remember when we first started grinding and polishing forged hammers. Unit cost per hundred hammers ground that first year was three times what it is today. The machine method has changed little on this particular operation, but the coated abrasive belt has undergone a real revolution . . . particularly as concerns the bonding and the method of applying the mineral to the backing.

Longest Possible Life from An Abrasive Belt?

By "longest life" we mean the greatest productivity, since very often the abrasive cost is a negligible part of the operation. First of all, we have to recognize that because the mineral is on a flexible backing, and because the mineral particles are oriented for sharpness and disposed as to height for continued cut, that extremes of pressure should be avoided. And when extreme pressure is essential, a coolant-lubricant should be used to take some of the gaff.

In belt form, coated abrasives are the coolest cutting grinding medium there is, so they can be run faster and produce more in a given time. Limits to effective belt life are determined by several factors we can talk about later. But if one is aware that up to 70% of the life of a coated abrasive belt is accomplished with minimum pressure, then these factors can be easily recognized and integrated. Some of these factors include: type of metal, grit size and diameter of contact wheel. Others are flexibility of the coated abrasive, hardness of the contact wheel, coolant, horsepower, belt and spindle speeds, chip clearance, and even more. Naturally, some are more important than others.

Grit size and hardness of contact wheel are very basic. And just as important are speed, type of con-

tact wheel and its size, lubrication, grinding pressure, belt tension and type of mineral. All of these factors are interrelated, and there are some constants to use as guides. For instance, one example is that softer contact wheels produce a finer finish than harder contact wheels, assuming the same grit belt. Chart 1 indicates that where a 90 durometer contact wheel produces an RMS of 23, a 30 durometer wheel yields an RMS of 10 for a given grit. These readings were taken at the so-called "plateau" of the graph, where the RMS readings vary very little. This plateau can account for up to 70% of the belt life.

How to Select the Correct Belt

The first consideration in selecting the proper belt is the type of operation; that is, whether it's stock removal, finishing or polishing. Then, determine the type of finish the work piece is to receive ultimately. If the piece will be painted, for example, the final grit will be in the 100 to 150 range; but if plating is the end finish, the metal is usually oiled out with grits in the 180 to 400 range, depending on the type of plate—that is, whether it's copper, nickel or steel buffed.

The type of bond and backing are also dependent on the operation. Where intense frictional heat will be generated, a Resinite or Resin Bond construction is used on a cloth backing. For cooler running operations, where pressures may be light, a glue or glue-and-filler bond and a paper backing will suffice. Flexibility is also a factor, remembering that the tougher the bond and the heavier the backing, the less flexibility there will be. A rule of thumb is to use the most rigid construction possible, assuming other factors have been satisfied.

Speed Is Important in Obtaining a Desired Finish

One of the big advantages of the coated abrasives system is that operating speeds are higher than they are for other methods, offering a faster cut. Belt speeds are measured in surface feet per minute and are based on the spindle's RPM in relation to the size of the contact wheel. Speeds measured in SFPM range all the way up to 10,000, and are dependent, among other things, on the condition of the machine.

The easiest way to illustrate how speed affects finish is to chart the results of a test run with all factors (contact wheel hardness and size, grit, workpiece, pressure, etc.) constant except for speed, as illustrated in Chart 2. Since a speed of 3200 SFPM produced an RMS reading of 14—and there is an inverse ratio between speed and RMS reading down to where a speed of 10,000 SFPM produces an RMS of 6—we can assume that higher speeds result in finer finishes. The RMS changes little over speeds of 7500 SFPM.

Contact Wheel Size Has a Bearing on Finish

To the extent that everything else remains constant, a larger diameter contact wheel will produce a lower RMS reading than a contact wheel of smaller diameter. This is because on a large wheel the pressure exerted by the workpiece is spread over a larger area, so the pressure per square inch becomes less than with a small wheel. Less unit pressure gives a finer finish. That's because wheel hardness plays a part in finish, and for about the same reason that a larger wheel gives a finer finish, so does a softer wheel. Again with all things being equal except the durometer of the contact wheel, as Chart 1 shows, a 90 durometer wheel produces a 23 RMS reading and the 30 durometer produces 10 RMS. It should be noted, however, that harder wheels and/or small diameter wheels produce a shorter, narrower scratch pattern, and one that is not deformed by a

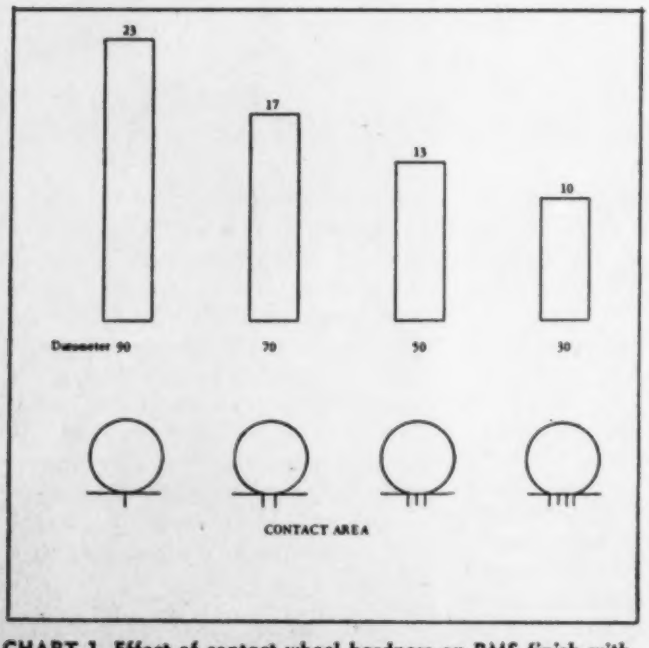


CHART 1. Effect of contact wheel hardness on RMS finish with abrasive belts.

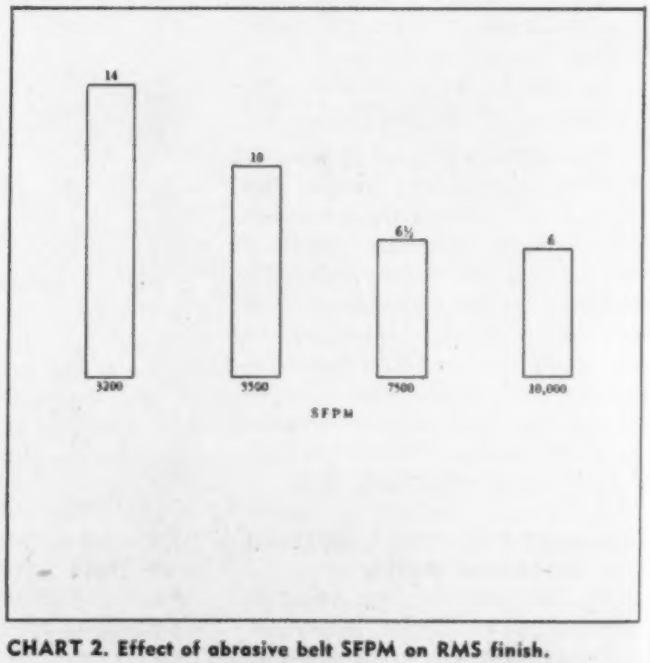


CHART 2. Effect of abrasive belt SFPM on RMS finish.

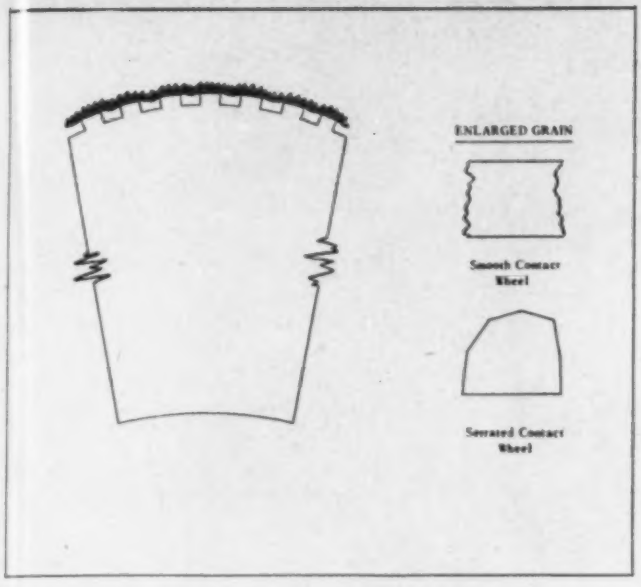


CHART 3. Effect on contact wheel serration on mineral wear.

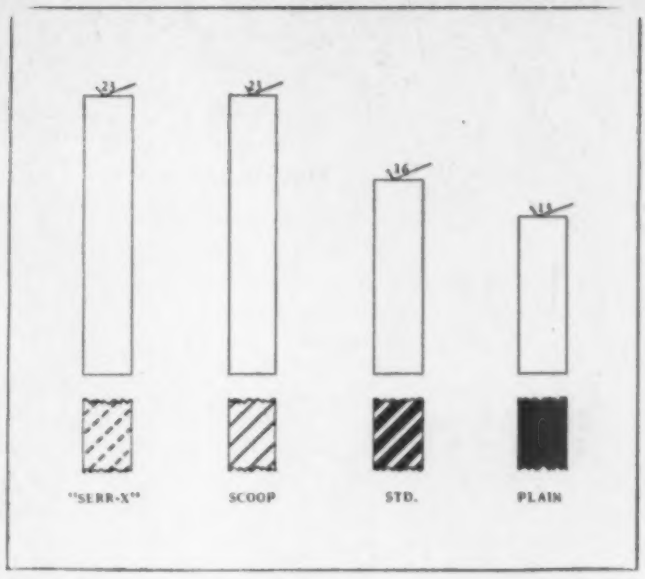


CHART 4. Effect of contact wheel serrations on RMS finish with abrasive belts.

continued

chip smothered in the contact area.

Contact Wheel Important to Abrasive Belt Performance

Except for free-of-belt and semi-supported strapping operations, something must support the belt. On some types of machines, support is supplied by a platen. But in the majority of cases, it is the contact wheel that lends the support, and the action of the wheel governs the action and effective penetration of the individual mineral grains on the belt. A contact wheel with a serrated face, for instance, has a different effect on the mineral than does a plain face wheel. Chart 3 illustrates this point very well.

A serrated or slotted wheel actually lengthens effective belt life in many cases. Slotting the contact wheel has the unique effect of sharpening the mineral grains as they undulate over the face of the wheel. A plain face wheel puts all the wear on one plane on the mineral, and gives it a flat surface. Re-

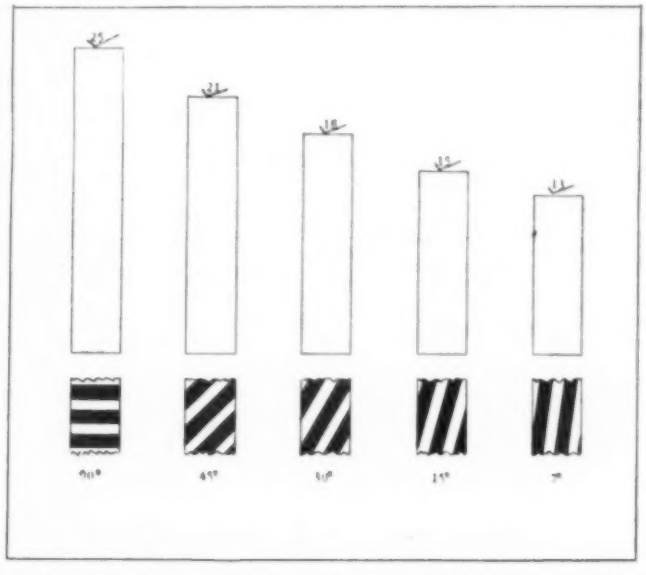


CHART 5. Effect of contact wheel serration angle on RMS finish with abrasive belts.

TO CHANGE RMS

FORMULA:

$$\text{Stock Removal (Oz. per Sq. Ft.)} = \frac{\text{Change in RMS}}{\text{Constant}}$$

EXAMPLE:

1. Carbon Steel—Constant (C) 174
2. Reduce 35 RMS to 15 RMS (Change of 20 RMS)

$$\text{Stock Removal} = \frac{20}{174} = .115 \text{ Ounces per sq. ft.}$$

THE CONSTANTS:

Carbon Steel	—	174
Stainless Steel	—	180
Aluminum	—	515
Brass	—	157
Copper	—	152
Titanium	—	310
Cast Iron	—	191

CHART 6. Determining amount of stock removal.

member, though, that slotting is a secondary factor in selection of a wheel and coated abrasive. The first consideration is the productive result on the workpiece—not belt life.

With some notable exceptions, there are two types of contact wheels, plain face and serrated, but there are many types of serrations. When a wheel is slotted, lands and grooves are produced. The "lands" are the raised strips between the grooves, on which the belt rides. The relationship between the lands and the grooves, and the angle at which they cross the face of the wheel, determine to a great extent the aggressiveness of the wheel. Aggressiveness is further determined by durometer, or hardness.

Take a look at Chart 4. This gives RMS readings where everything was constant except the type of wheel. The reason why the "Serr-X" wheel and the scoop produce rougher finishes (higher RMS readings) is that when you widen the grooves you increase unit pressure and permit a deeper scratch pattern.

Here's How Hardness Fits Into the Picture

Because rubber, like water, is noncompressible. When you push on one spot it bulges somewhere else. In slotting, the rubber land can distort into a void, or some types actually fold over to some extent. Since this increases resilience and conformability, and lowers the functional hardness of the wheel, slotted wheels should have a durometer 10 to 30 points harder than the durometer of a plain face wheel for a given application. We have developed some rather interesting procedures to test the functional hardness of wheels to accurately gauge their dynamic resilience at operating speed.

Effect of the Angle of the Serration Across the Face of the Contact Wheel

The angle of the slot is measured as 90-degrees being straight across the face of the wheel. The other extreme would be a 7-degree angle, something like a screw thread. Some different angles are illustrated in Chart 5. The lower the angle toward 15-degrees or 7-degrees, the finer the finish and the lower the RMS reading. Slot angles of 30-degrees or less are usually employed in the polishing operation. The 90-degree, for all its progressive impact action, often makes a siren-like sound and frequently leaves a pattern in the work. The 45-degree angle is the largest one that will run relatively quietly in an average backstand operation.

The Mechanical Process for Lowering a High RMS Reading

The coarse grit belt was used to remove stock, and thereafter substantially little change will be made in the gauge of the metal, as measured from the bottom of the deep, coarse belt scratches. RMS is reduced by cutting off the tops of the ridges between the deep scratches. We've run some tests along this line to determine the amount of stock removal required to effect a given change in RMS reading. From these tests has come a formula, as illustrated in Chart 6. • • •

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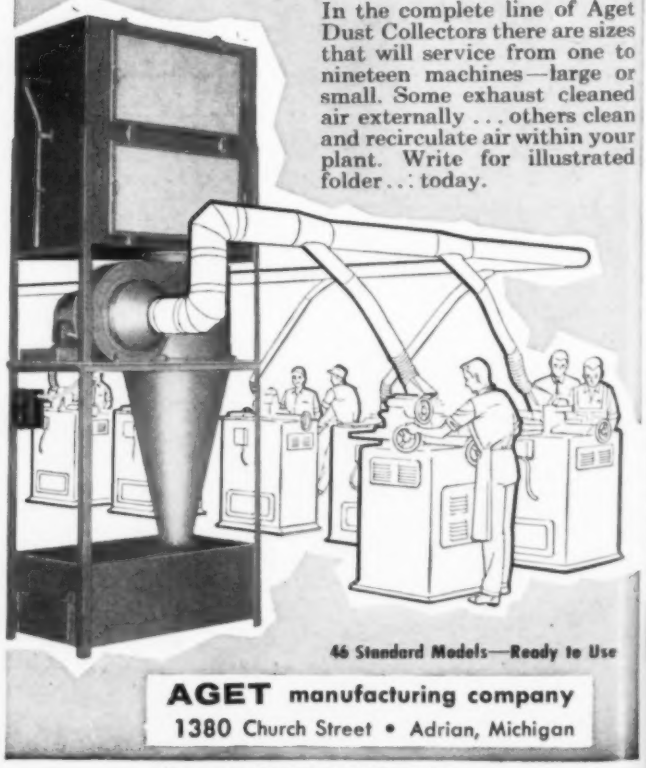

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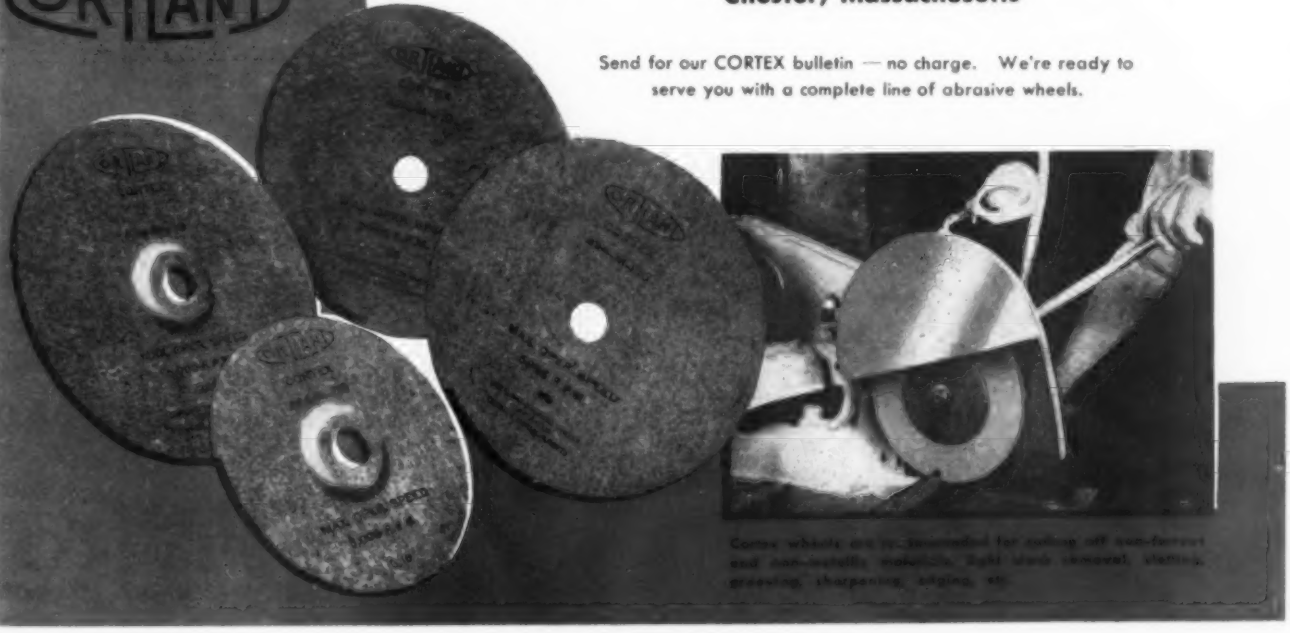

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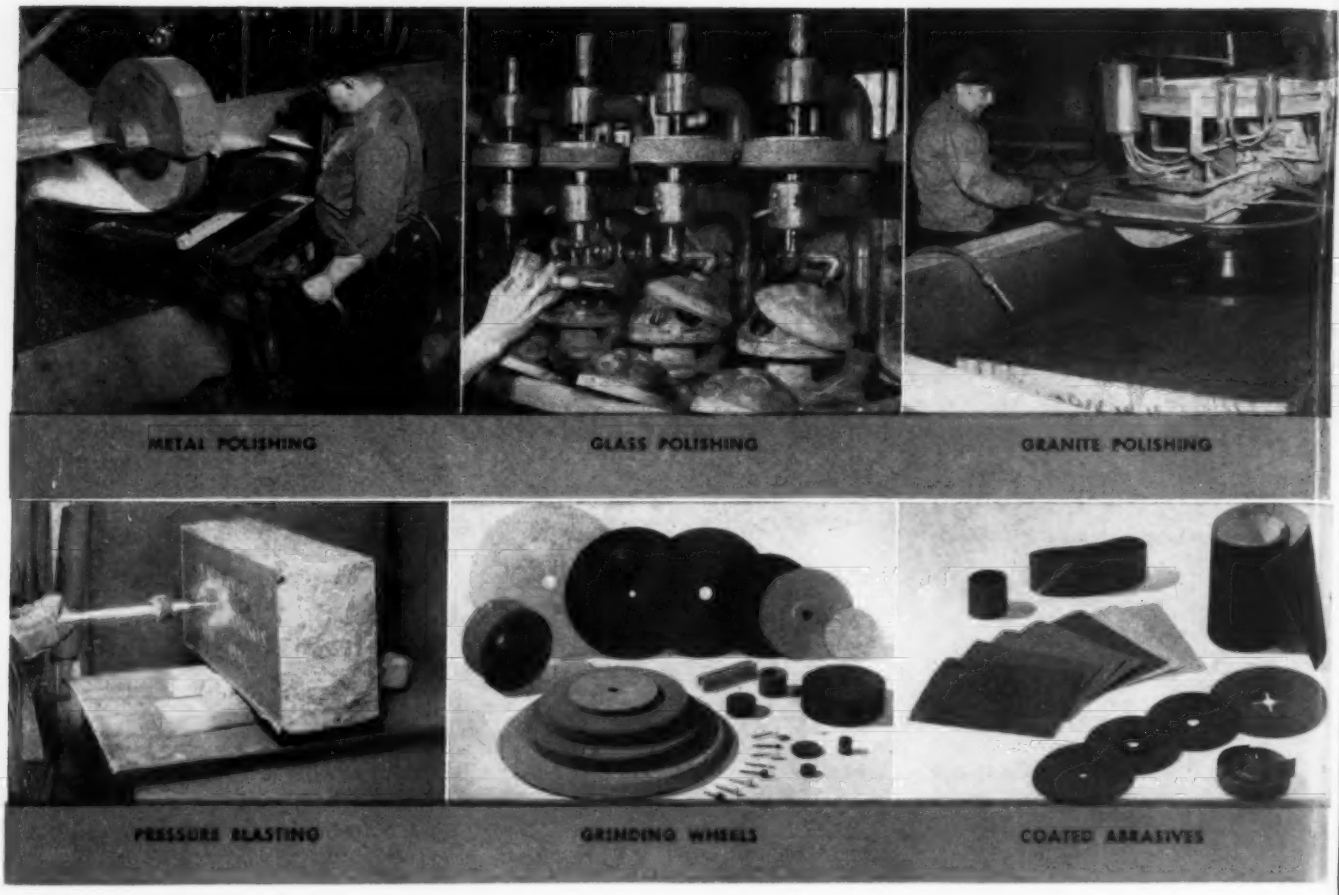

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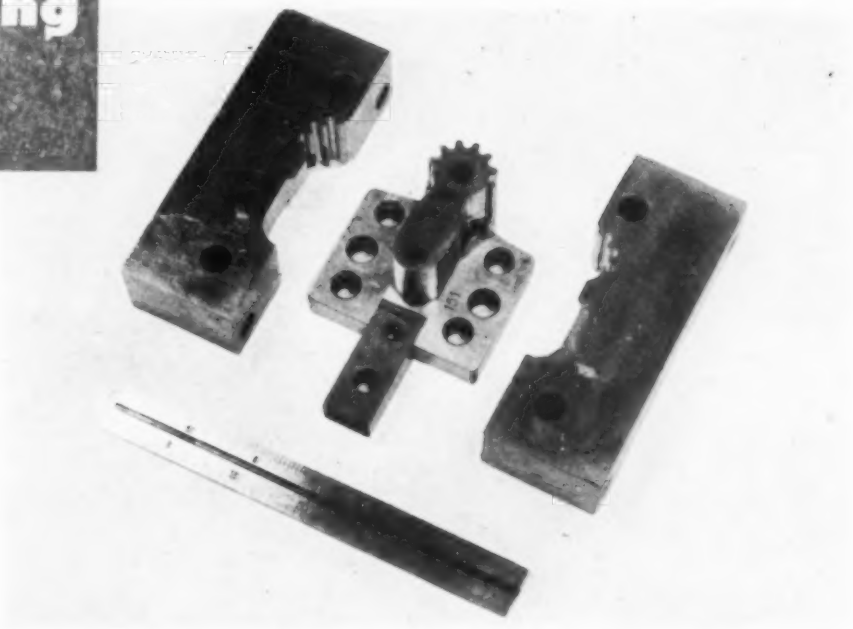
grinding and finishing

Toolroom Grinding



This punch and die section was

Form Ground in 20 Hours

instead of an estimated 60 to 70 hours

by **William J. Knuff,**
Service Manager
Cleveland Grinding Machine Co.
Cleveland, Ohio

● First class grinding of precision dies has been a problem for manufacturers for several years due to the shortage of skilled grinder hands.

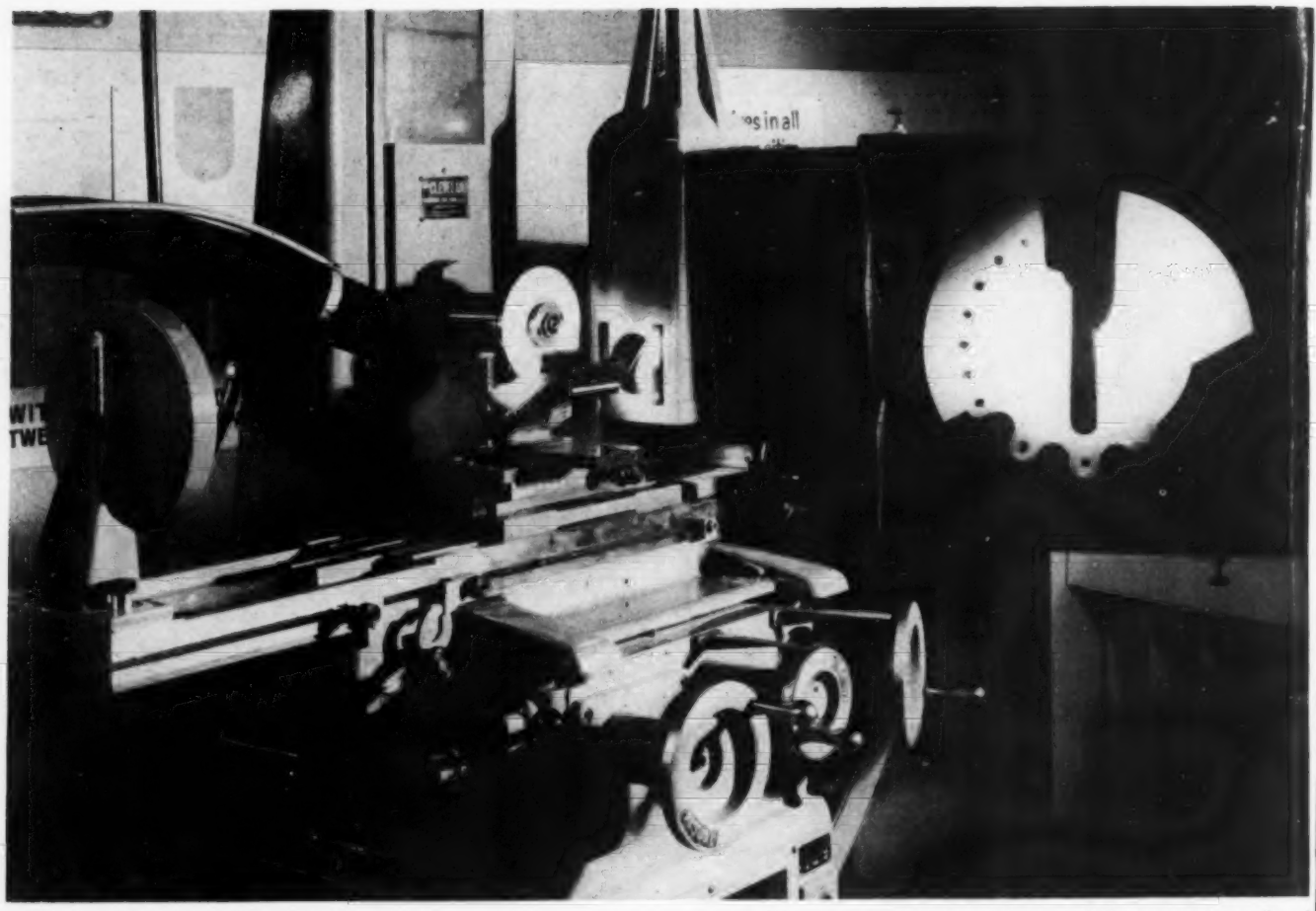
This problem was recently faced when a manufacturer found he could not build a complicated punch and die section, figure 1, in his own shop in time enough to relieve shut down of his production line. This stoppage was due to a broken die. He estimated that it would take 60 to 70 hours to grind the punch and die section.

By applying the principles of optical projection grinding, the punch and die sections for a venetian blind ratchet, figure 1, were finish ground in 20¼ hours by semi-skilled operators. These sections, which were designed to stamp approximately 1/16-in. cold rolled steel, were manufactured out of Vega die steel and heat treated to a Rockwell hardness of 62-C.

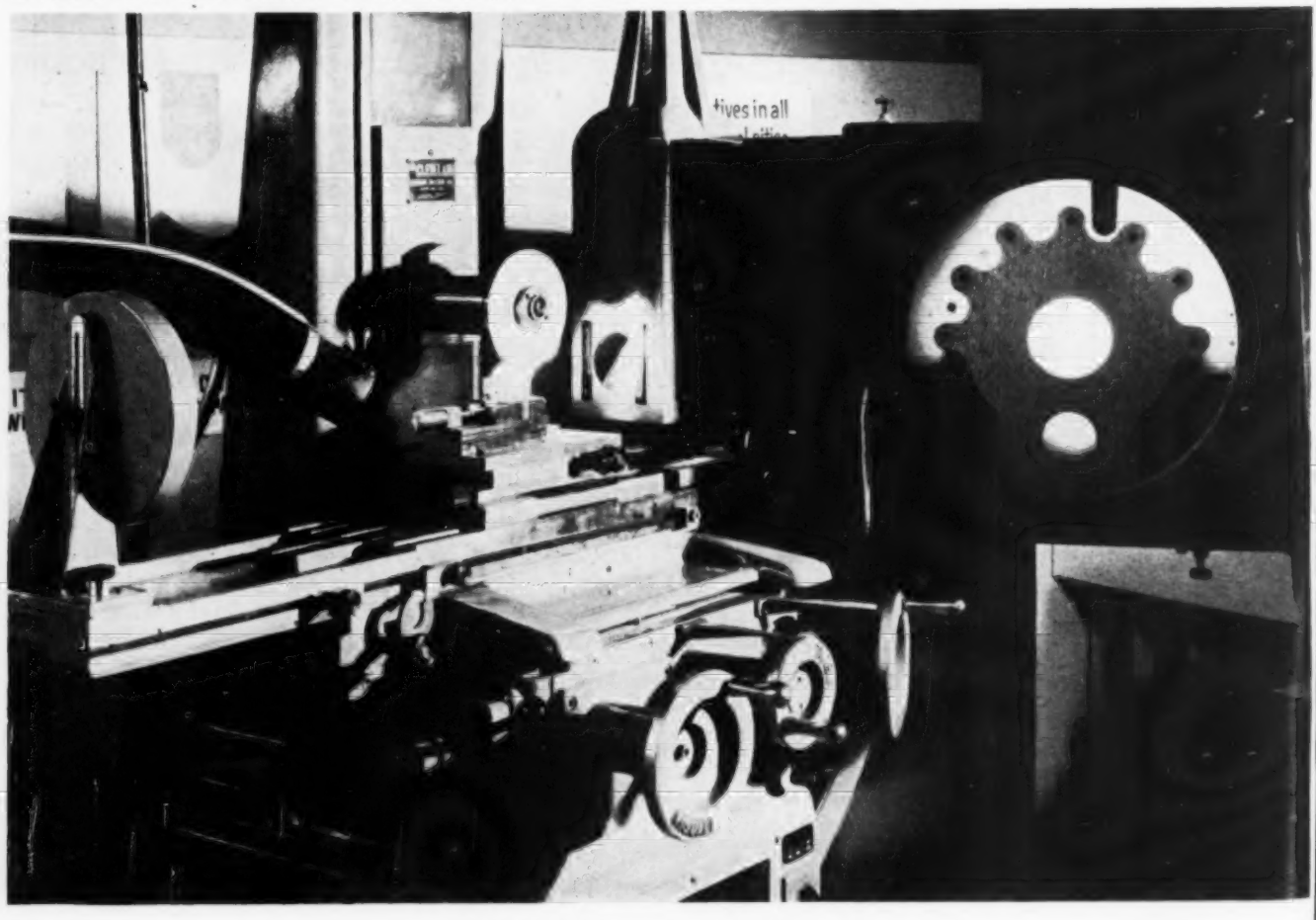
An optical projection grinder is primarily a surface grinder with a "built-in" optical comparator. An image of the work being ground is projected from 10:1 to 100:1 magnification, onto an 18-in. glass screen on which the desired form is

Only 12 hours were required
for the actual grinding operation

The die stock was Vega heat treated to a 62C Rockwell. An optical grinding machine was used on which tolerances of plus or minus .0001-in. are possible. No taper was required; two die sections were ground simultaneously. The finished punch and die section did not require additional stoning or lapping. Form grinding required 12 hours; completed job required 20¼ hours.



2. (Top): **THE TWO DIE SECTIONS** are set up on the magnetic chuck of the machine. The magnification is 20:1 on the screen.
3. (Bottom): **ONE SECTION** of the punch projected on the screen. The strong contrast on the top of the screen is produced by a reflecting mirror which is protected by a clear glass cover at the left end of the table.



no stoning or lapping was required . . .

already drawn at an equal magnification.

By grinding to this comparator screen, it is possible to grind contours to a tolerance of plus/minus .0001-in. without intermediate checking. The operator can actually watch the magnified wheel and work contact. Accuracy, surface finish and surface condition is controlled.

The first step in grinding this punch and die section was to have the draftsman draw the gear segment form on the ground glass screen at a 20:1 magnification using a 9-H lead pencil. Two lines were drawn; one represented the punch, the other the die section with the space between being equal to the die clearance.

A draftsman has little difficulty in making an accurate chart. This chart eliminates the necessity of having the grinder hand do a lot of surface plate figuring and inspecting. Time required to draw the chart was 2¾ hours.

The squaring-up of the punch and die section and grinding the relatively simple part of the form was accomplished by using standard surface grinding techniques. Time required for this was 3½ hours. Figure 2 shows the two die sections set up on the magnetic chuck of the Visual Grind, an optical projection grinder manufactured by Cleveland Grinding Machine Co.

Since no die taper was required, a grinder hand was able to grind two sections at a time. Although these sections are shown on a sine plate, no particular attempt was made to use a specific angle, but only the one angle which afforded the best accessibility for grinding of the form. The chart was rotated in the rotary aluminum frame with graduated degrees until the chart and die sections corresponded.

The grinding wheel used was a 6 x ½ x 1¼ 38A46-G12 V BEP turning at 3600 r.p.m. The gear segments were ground from a solid; neither the punch nor die sections were preformed.

A wheel with good grinding properties was selected; however, little regard was given to its form stability because there is no need to be concerned about wheel breakdown.

For these die sections the wheel was dressed twice; once for roughing out the form and once for finishing (the finish was about 32 micro inches).

The grinding wheel was dressed with a convex radius somewhat smaller than the smallest radius on any part of the punch or die sections. As a result, only a few minutes were required to set the radius dresser and dress the wheel.

By generating the form and following the chart, a true form can be maintained which permits using the wheel that cuts most efficiently.

Also by generating a form, relatively small surface contact is made between the grinding wheel and the part being ground, resulting in considerably less heat than that produced by a full formed wheel. The slightest heat discoloration of the steel would be noted on the screen since the image is a projection and not a shadow. By keeping the cutting edge of the punch and die free from overheating, the die life is considerably prolonged.

Figure 3 shows one section of the punch projected on the screen. The chart lines, although difficult to see in Figure 3, are very distinct to the operator sitting in front of the screen. The strong contrast on top of the screen is produced by a reflecting mirror which is protected by a clear glass cover at the left end of the table. In a scene, it is possible to see and grind through the section of the punch with this bright background. The area with the dark background shows the punch with a heel or base.

Figure 4 shows the punch positioned to facilitate the use of a small one inch grinding wheel mounted on the high speed quill (20,000 r.p.m.). The high speed attachment is mounted on the standard grinding spindle.

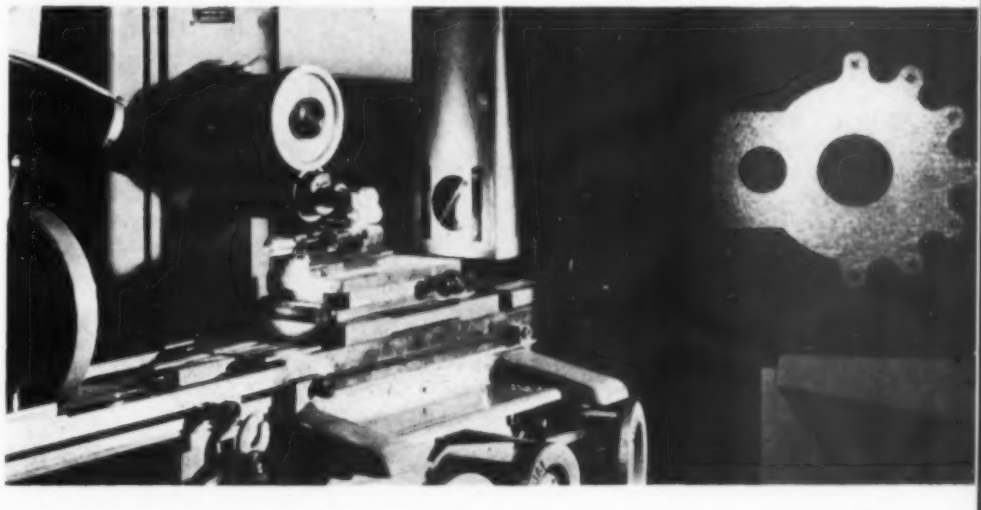
The image on the screen does not have a background light. Illumination is provided by the unique surface projecting ability of the machine. The wheel used in this instance was a 1¼ x ¼ x ¼ 32A60 L5 VBE at 20,000 r.p.m. No form was dressed in this wheel.

When actually grinding, the operator can see enough to grind to the chart line not quite visible in Figure 4; although, this is not quite as brilliant as in through grinding.

When removed from the machine the punch and die sections did not require any stoning or lapping and had a good uniform clearance. The time required for the form grinding was 12 hours or a total of 20¼ hours for the complete job. This is compared with the 60-70 hour estimate.

• • •

4. THE PUNCH is positioned to facilitate the use of a small one inch grinding wheel mounted on a 20,000 rpm high speed quill.



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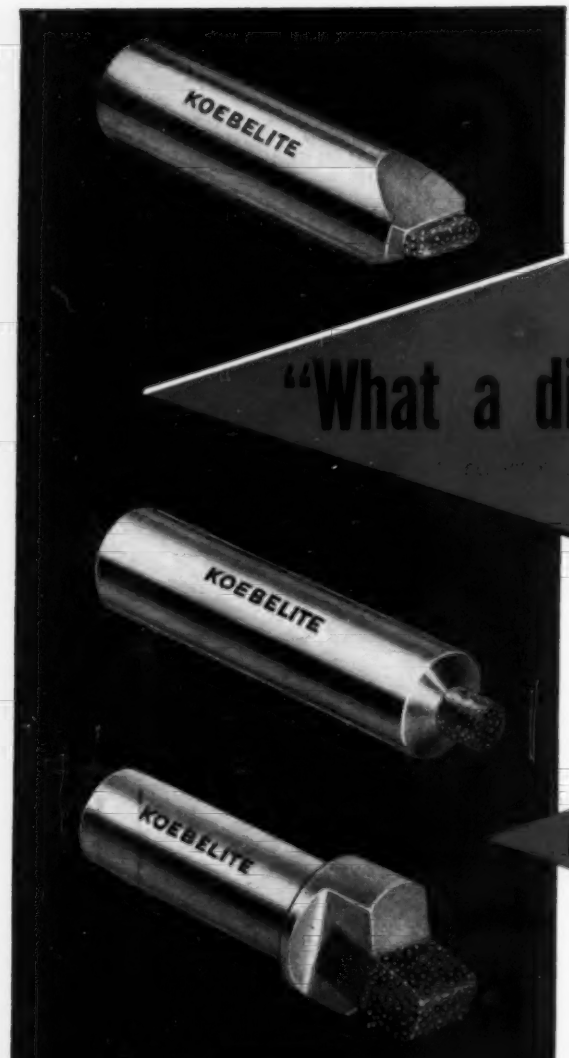

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Over and over we hear this from people after they try (and then standardize on) KOEBEL CDP* dressing tools for grinders.

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- there is no wastage. CDP* gives the most efficient use of diamond caratage conceivable.
- you eliminate diamond resetting.
- you get more pieces per dressing.
- longer wheel life cuts wheel costs.
- you cut diamond tool costs (see example).

CDP* tools are different—IN PERFORMANCE

- there's a big difference in results (see typical example).
- they even do jobs big single diamonds can't do efficiently.
- they take the guesswork out of diamond performance by insuring *uniform* results, tool after tool.

Yes, CDP* tools are different

- there is no quality variation in CDP* dressing tools.
- it is their design and manufacturing uniformity that gives you such uniform results.

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CDP* – Cemented diamond particles—small diamond particles set into a matrix which automatically adjusts itself to diamond wear.

A typical wheel dressing example

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pcs/dressing	12	25
cost/100 pcs.	1.7 cents	0.5 cents

(¼ the tool cost per piece, half the wheel cost, less downtime and double the wheel life.)

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5th European Machine Tool Show, Hannover, 1957

Grinding Machines Which Stopped Us

By **William F. Schleicher**
Editorial Director

- √ ***well built, well designed equipment marks continuing improvement in machines and equipment***
- √ ***trend is toward higher precision and super-fine finishes***
- √ ***grinding as a primary metal removal operation not too much in evidence***
- √ ***emphasis placed on new concepts of grinding machines***
- √ ***automatic loading and automatic sizing widely used***
- √ ***a number of unique and interesting machines***

• The following few descriptions can serve only as the sketchiest indication of some of the grinding machine developments displayed at the Hannover show. Many worthwhile developments are not discussed due to lack of space. Generally speaking, European grinding machine developments during the past few years should slay, once and for all, the misconception that their machines are still in the dark ages of development. Nothing can be further from the truth, and one misconception to guard against is the idea that their machines are light, manually operated, weak little infants. To be sure, they showed standard machines which were extremely flimsy with spindles suited for the grinding of soft cheese and motors with barely enough poop to turn the wheel slowly; but these were the exception. Let us not be misled by them.

Someone has said that Europe lagged behind the U.S. in automatic cycling and automatic sizing, as well as automatic loading. We found no evidence of this whatsoever. As for automatic sizing: it was not a question of is it available, but a question of, how many do you want? No, automatic cycling, automatic sizing, automatic loading and unloading are in the

continued

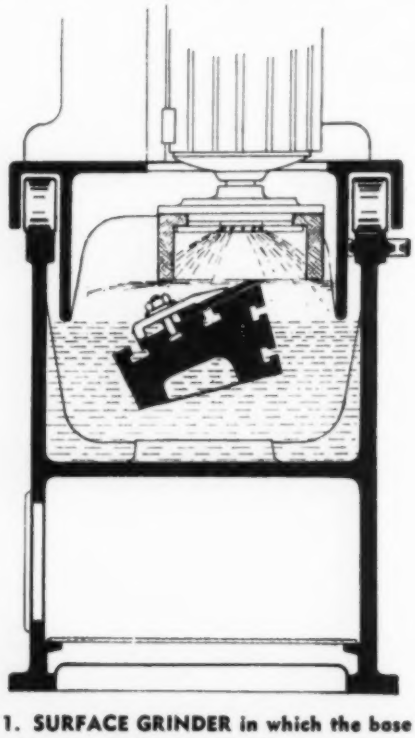
forefront. If the machine on display didn't have the automatic features on it, ". . . . we'll put it on."

The European machine tool builders appear to be readily adaptable. (We're speaking primarily of machine tools in general.) You don't like the head where it is? We move it. So! Table not long enough? I happen to have a longer one right here. A machine tool builder from Cincinnati with whom we talked shook his head and said, "These fellows will make any change, build anything on you want, put the controls where you want them and think nothing of it." Of course, cost is on their side, something which must never be overlooked!

What of the future? For one thing, the Europeans appear to be concerned primarily with grinding as a final finish operation and are concentrating on perfecting machines which will provide higher accuracies and better finishes. We may, in this respect, expect even more precise machines in the years to come. Whether the cost of such work is justified is, in the last analysis, dependent on the buyer, and here again we must remember the European is building primarily for the European and other world markets, and only secondarily for the American market. Consequently, his machines must be adapted for the production problems of Europe which differ in many respects from those in America. Strangely enough, no strong bid was made for grinding as a metal removal operation; i.e. taking the operation from other machine tools and doing the job faster and more efficiently by grinding.

The Hannover show did reveal one interesting trend: that of taking a fresh look at the basic concept of grinding and changing the fundamental design principle. One German machine tool builder said he felt that further improvements in the grinding process could only come from new and revolutionary concepts, and it was in this direction that he and his firm were traveling. That new ideas were already on display is proved by the zig-zag grinder, the pantograph form grinder, the centerless with the wheels located above one another instead of opposed as in conventional machines and the grinding of work while the machine base is filled with coolants. (These, and other designs are discussed in the following paragraphs.) Whether these ideas are sound or not, only time will tell. Of importance to all of us must be the realization that the rest of the world is not standing still, but moves irrevocably forward.

Examples of differing types of machines hooked up in sequence as shown at the Chicago show in 1955, such as the bearing race line on which three manufacturers cooperated, were not in evidence. While one saw two or three centerless grinders hooked up in a line, the mixing of, for instance, a disc, centerless and internal grinder was not prominently shown. Nor did one see huge special machines on the order of Norton's crankpin grinder, although special camshaft and crankshaft grinders made a strong bid for attention; however, there is a strong trend toward special machines, especially among the German manufacturers. One must look forward in the next few years to their doing a great deal with this sort of thing.



1. SURFACE GRINDER in which the base acts as a coolant reservoir.

Grinding in Water

Somebody once said, the best place to grind is in a swimming pool. A German firm has come close to it; they have a surface grinder which grinds while the table is submerged in water, figure 1.

The base of the machine serves as a coolant reservoir and as a working area and is rigidly ribbed and well constructed. The grinding carriage, carrying the vertical head, rolls on needle bearings on the guideways of the grinding bed. The guideways thus are higher than the grinding surface. This construction, according to the manufacturer, Gustave Goeckel, Darmstadt, W. Germany, has these advantages: 1. dust and dirt cannot lodge on the guideways; 2. the carriage rolls on ways above the workpiece; 3. grinding and grinding surfaces are parallel, guaranteeing a high precision; and 4. steel bands on way protect accuracy.

The grinding base, or bed, which houses the table, is filled with coolant, eliminating the problem of heat. The coolant is fed to the grinding wheel from the center of the cup wheel and is directed to the inside edges of the wheel, cooling both work and wheel at the same time.

The stationary table can be tilted with a scale; when it is in a horizontal position it is entirely out of the water. The entire table can be loaded. Because the head moves and not the table, loading and unloading can be done while work is in progress.

Power of five different models ranges from 3.7 to 40 h.p.; a 6-in. cup wheel is used on a 20-in. head.

Zig-Zag Grinding

A vertical spindle rotary table machine uses a highly unique new grinding concept: zig-zag, or figure grinding, as it is called by the

manufacturer, Karl Mengele and Sons, Gunsberg, W. Germany.

In this method the workpiece is clamped to the rotary table. The rotary table turns while at the same time the carriage of the machine follows a series of patterns, or configurations. Thus we have a combination of rotary action of the table combined with a horizontal action of the carriage. This is best seen in figure 2.

This enables you to cover a large surface with a comparatively small grinding wheel, particularly advantageous when grinding a ribbed casting, or a casting with a number of raised bosses. Parallelism can be held to .0004-in. on larger pieces and to .00005-in. on smaller pieces.

During each revolution of the table the carriage also completes one figure, the wheel thereby being in contact with every square inch of the surface to be ground. The rotation of the table and the configuration of the carriage is repeated until the specified amount of stock is removed. The speeds of both table and carriage are stepless, i.e. variable. The pattern results from the shape of the workpiece by setting the rotary speed of the table and the speed of the carriage, including its reversal.

The movement of the table, forward and return, is guided by a cam which imparts the zig-zagging, or configuration, to the movement. Three cams are available: a rectangle, a square and a triangle, see figures 3, 4 and 5.

If the zig-zagging is not required, the grinder can be used as a plain rotary grinder or as a reciprocating table grinder. Feeding is automatic.

Loading on Cylindrical Grinder

Fully automatic cylindrical grinders with several interesting loading and unloading devices was one of many different types of grinders with similar automatic features.

For loading and unloading workpieces on a grinder made by the Fortuna Werke, Stuttgart-Bad Canstatt, Germany, a hopper feed and a drum-type loader is used. Workpieces slide from hopper to the loader and then centered. The action is controlled by the Finitor Measuring Head. The Finitor controls the following operations: loading of work pieces, infeed of the grinding wheel, adjusting from rough to finish grinding, removing finished work pieces and loading a new piece, truing grinding wheel with a hydraulic truing attachment, and shutting the machine off when the hopper is empty.

The same company showed an interesting cylindrical grinder having two independent spindles. This makes possible the simultaneous grinding of several diameters on the same shaft on which the diameters are located at some distance from each other. Two automatic sizing attachments can be utilized, also working independently of one another.

For Curved Tubes and Pipes

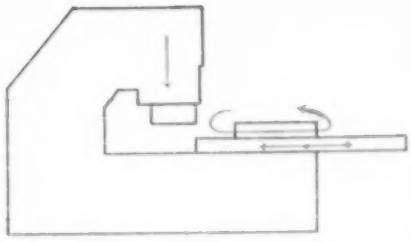
If you're interested in grinding and polishing bicycle handle bars or other curved round tubes or pipes, there's a rather ingenious abrasive belt machine, made by Greif-Werk, Hagen-Haspe, W. Germany.

On a drum *A* are mounted four wheels *B* and *F* (*F* are two driving wheels for the belts *C* and *B* are idler wheels). The belts pass over the platen rollers *D* which guide the belts against the work. The drum, with wheels and belts attached, revolves around the work *W* 138 times each minute.

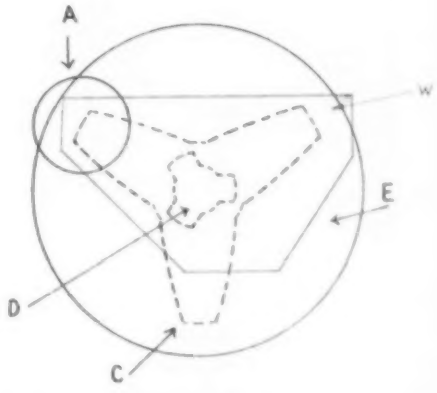
Figure 6 shows the unit, prior to grinding, in a stationary position. In figure 7 the loaded machine has begun its cycle. This is done by means of a foot pedal. With the pressing of the foot pedal the two platen rolls *D* contact the workpiece *W* which also begins to revolve. Now the entire drum turns, the belts and workpiece also revolve. All the operator needs to do is move the workpiece back and forth. Manufacturer claims that a handle bar can be ground and polished in a minute. Machine is enclosed and completely dustfree. Rough grinding, finish polishing or fine polishing belts can be used.

Internal Polishing of Dies

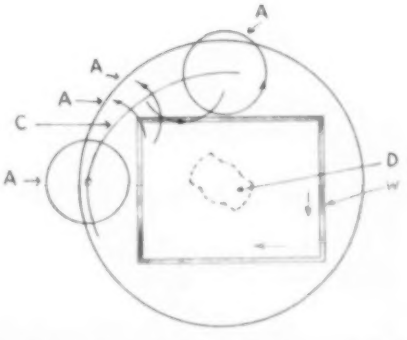
For the internal grinding and polishing of drawing dies an inter-



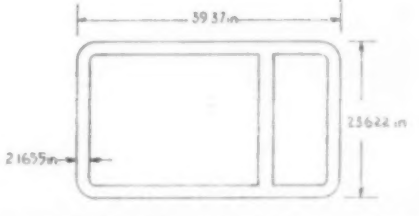
2. PRINCIPLE OF THE ZIG-ZAG, or figure, grinder showing rotary table movement and reciprocating carriage movement.



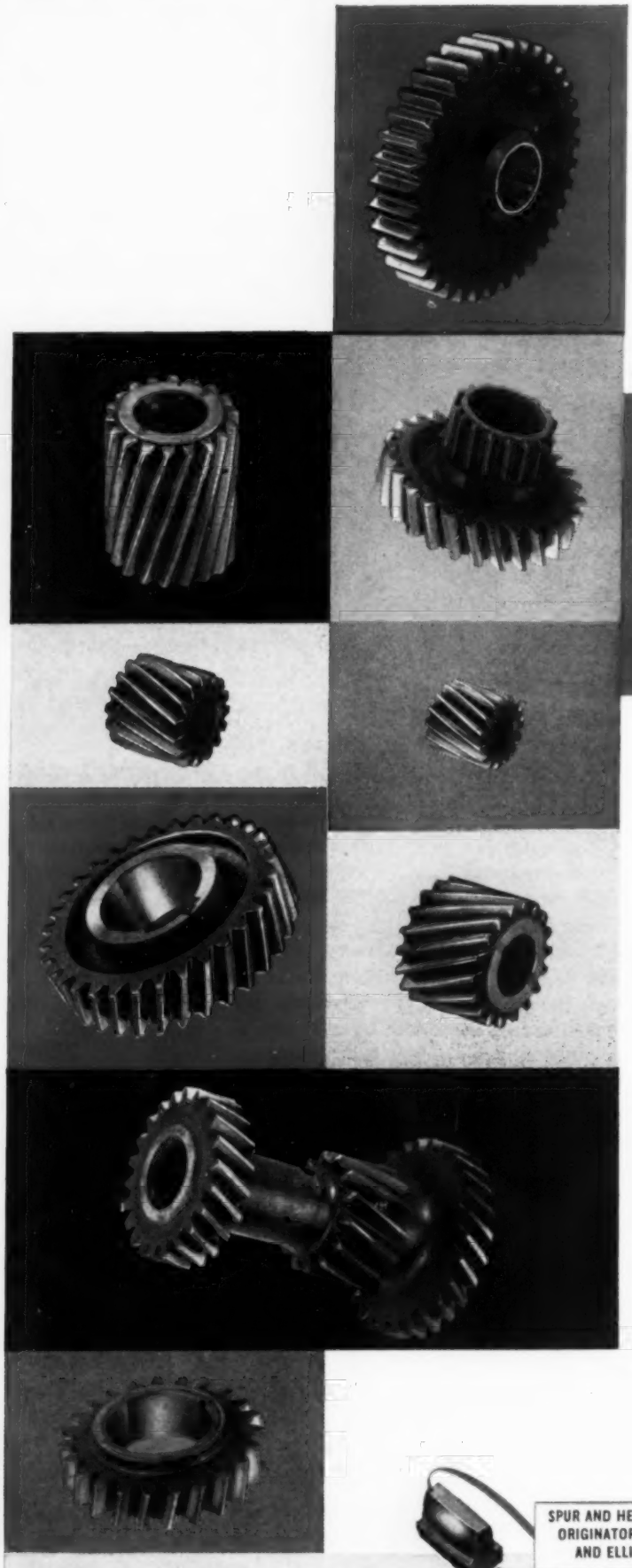
3. THE ZIG-ZAG GRINDER on a flat surfacing job. W is the workpiece, A is the grinding wheel, E is the rotary table, D is the cam which supplies the zig-zag motion, C is the path of the grinding wheel.



4. SURFACE GRINDING of a ribbed rectangular casting. W is the workpiece, A is the grinding wheel, C is the path of the grinding wheel, D is the template, E is the rotary table.



5. THIS RIBBED CASTING was surface ground in three minutes.



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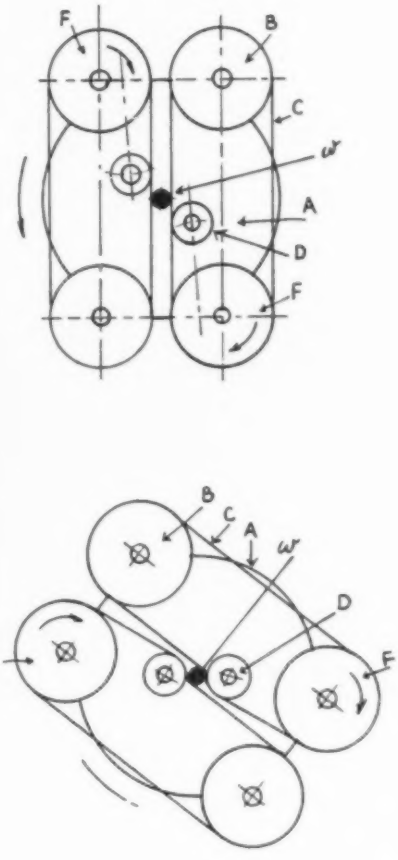


6. (Top) is the tube polishing machine in stationary position. 7. (Bottom) the work W has been engaged by the belts C and grinding action is taking place.

esting belt machine is available from Stenzel & Co., Wiesbaden, W. Germany. Figure 8 shows, in rough fashion, the operation of the machine. A drive wheel *A* drives an endless belt *B*. The belt is guided over two roller guides *G* which are adjustable horizontally or vertically; changing the location of the roller guides influences the radius to be imparted to the die *D*. The belt flows through the die and circles two other rollers *G* under the die by which means another radius is imparted to the bottom of the die, if desired. If no radius is needed on one end of the die the wheel *H* is used. This wheel is interchangeable for large and small holes.

While the belt is operating and polishing the work *D* the table on which the workpiece is mounted also revolves. In this way the entire internal area of the die is polished. The guide wheels *G*, located above and below the work, can be adjusted in such a manner that any desired radius can be generated at the mouth of the die.

Pantograph Profile Grinder

A copying profile grinder works on the pantograph principle with a ratio of 1:1 or 1:100. The grinder needs no optical equipment, enlarging is by means of the pantograph linkage. The stylus feed along the template is automatic and tapered relief can be ground on dies at the same time as the profile. Stroke of the work table is 3.15-in. and the wheel dia. is 5.9-in.

Grinding can be continuous along a 6-in. long template. Feed of the grinding wheel into the work is completely automatic. Accuracy to .0002-in. is possible. Both hss and carbide form tools, as well as dies and punches, can be ground, using a diamond wheel, of course, for the carbide.

An example of the work performed by the grinder is shown in figure 9. The machine is made by Fritz Studer, Glockenthal-Thun, Switzerland.

Surface Grinder for Profiles

Another fully automatic profile grinding machine works on the surface grinder principle with a reciprocating table and a horizontal spindle. Machine, by Maegerle, Ulster, Switzerland, is especially designed for grinding large batches of profiles with high accuracy.

Table speed is up to 100 ft. per min.; wheel down feed is .0001 to .0005-in. The grinding wheel is crush formed. The crush forming device is built into the spindle head, being a unified part of the spindle head. When wheel wears it is re-crushed. There is a compensating device which compensates for the diminishing dia. of the grinding wheel; it also gives a check on the positioning of the wheel profile in relation to the workface.

Crush former automatically regulates spindle speed, maintains constant peripheral speed of grinding wheel. Hydraulically operated dressing diamond with the crush-forming device permits wheel dressing by both methods.

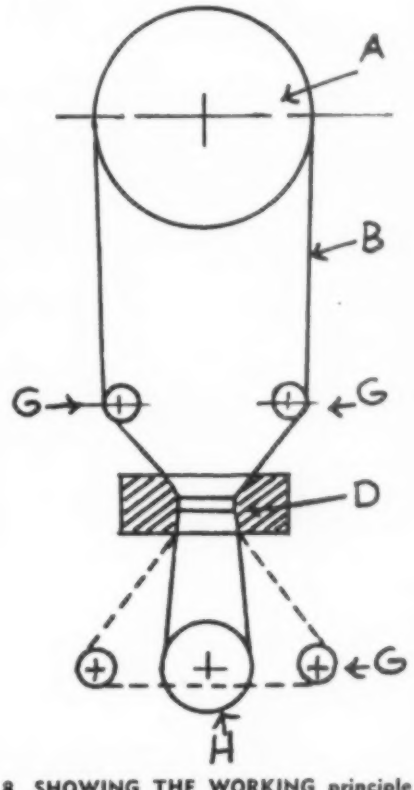
Internal Grinder

Internal grinding machines have come in for their share of attention. Voumard machines Co., La Chaux-de-Fonds, Switzerland, showed a model having a capacity of from 1 to 14-in. Automatic cycle control and automatic sizing is provided. Infinitely variable speeds of from 9,000 to 120,000 are possible.

Internal Grinding with Servo-Sizing

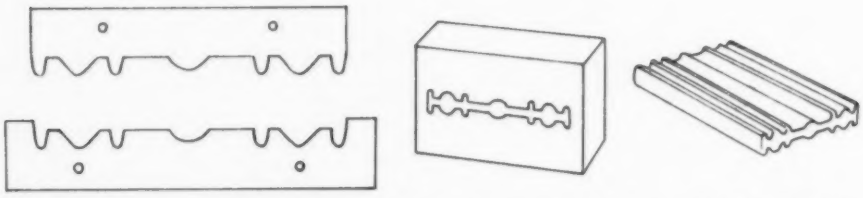
The UVA Servo-Sizer, an internal grinding machine made by Ulvsunda Verkstader AB, Stockholm, Sweden, incorporates a combined direct and indirect measuring system that provides automatic correction of deviations from the predetermine ideal size of the bore.

Servo-Sizing, combining diamond sizing and gauge sizing, provides automatic adjustment of the diamond. After finish grinding, com-



8. SHOWING THE WORKING principle of the internal die polishing machine.

continued



9. ON THE LEFT THE TEMPLATE for the punch and die sections. In the middle the die and on the right the finished punch, all completed on the pantograph form grinder. Grinding times for the die was 8-9 hours, for the punch, 11-12 hours.

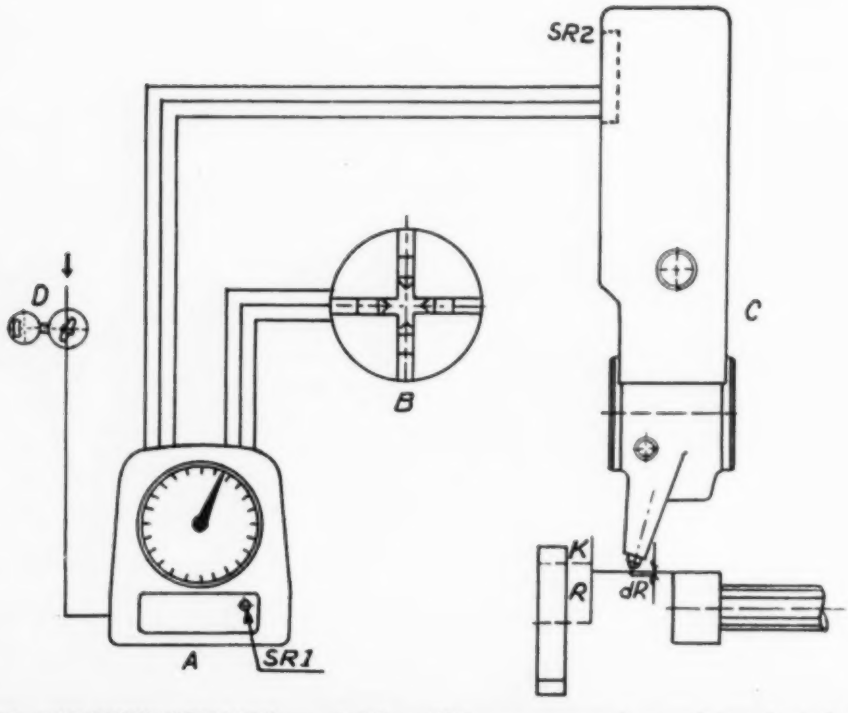
ponent is placed on air gauge equipped with an indicator showing deviations from ideal size. Air gauge is linked to servo-mechanism of truing device which then adjusts automatically when deviation exceeds predetermined value. This value is always well within the tolerance allowed for the size of the bore.

Figure 10 shows the pneumatically operated Servo-Sizing arrangement, where *A* is the dial indicator, *B* the air-gauge, *C* the truing device and *D* the air pressure reduction valve. The truing diamond is set at the distance *R* from the center of the bore. After roughing, the grinding wheel is dressed by the diamond, and for the finish grind fed the distance *K*. When the component just ground is placed on the gauge, the position of the truing diamond is corrected, if required, through the pneumatic circuits connecting the gauge with the truing device via the indicator.

Oscillating Camshaft Grinder

A camshaft grinder, made by Schaudt Maschinenbau, Stuttgart-Hedelfingen, West Germany, contains a newsworthy feature. This manufacturer's line has been completely overhauled. Electrical components are improved and bearings greatly strengthened. In addition, a new device was added to the camshaft grinder which imparts an oscillating motion to the wheel when the machine is set for plunge cut grinding. The amplitude of the wheel spindle oscillation is infinitely variable between O and 0.16-in. The manufacturer claims a greatly improved surface smoothness of the work.

To reduce the grinding time to a minimum the company introduced an automatic work speed changing feature which sets the work spindle speed to a lower rate when the machine changes from rough to finish grinding. This change is effected with a preadjusted amount of stock still on the work. As this attachment provides roughing at a higher speed, a higher production rate is claimed.



10. THE PNEUMATICALLY operated Servo-Sizing arrangement on an internal grinder.

4 to 40-in. Tool and Cutter Capacity

An automatic, hydraulically driven tool and cutter grinder attracted attention. This is built by Montanwerke Walter, Tubingen (Wurtt) W. Germany. Milling cutters of the most varied types can be ground, including side and staggered teeth cutters with radiused corners and negative face lands. Radii from 0 to about 4-in. of the cutting edges and their straight line continuation may be ground automatically in one operation without jig or template; the radii are thereby perfectly blended to the top and side faces. Capacity is 4 to 40-in.

All grinding operations, rotary grinding, index grinding, rough and finish grinding, etc., are performed without dismounting the cutter and in one set-up. Side and face cutters must be turned around for the grinding of the third side. The grinding wheel oscillates, making it unnecessary to true the wheel. The cutters are mounted horizontally and held exactly as on a milling machine, thus giving the best possible concentricity in one operation. All motions including the movements connected with indexing are infinitely adjustable.

Tracer Control on Surface Grinder

An interesting copying attachment is mounted on a standard surface grinder for the copy grinding of flat components. It can be

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used to grind, from a template, any profile up to 45° incline and widths up to 20-in. The stylus imparts control impulses from the template (which, incidentally, is the same size as the finished work) to an amplifying device. This actuates a reversing feed adjustment gear, designed for frequent clutching for the vertical travel of the wheel head. Table travel is 100 ft. per min., wheel head's cross feed is an adjustable amount up to .004-in. per longitudinal stroke. Made by Elb-Schliff Edmund Lange, Babenhausen-Hessen, W. Germany.

Size Control on Surface Grinder

Automatic size control is always news, especially when used on a surface grinder. The problem encountered in automatic sizing on a surface grinder is the difficulty of gaging the work because of the fast approach and run out of the wheel. Robert Blohm, Hamburg-Bergedorf, W. Germany, has found a solution by way of an electromagnetic spring system, by means of which the tracer, with a carbide ball fitted underneath it, touches down at any desired point of the machined surface during the stroke and is then immediately withdrawn. Thus, even grinding operations with a short stroke and high table speeds, can be automatically sized without trouble.

Grinding Two Sides

Grinding two sides simultaneously is accomplished by a surface grinder made by Diskus, Frankfurt A. M., W. Germany. A belt acts as conveyor for the workpiece. As the workpiece reaches the two vertical spindle grinding wheels it is switched to a slower moving belt to keep pace with the slower grinding cycle. The two vertical spindles engage the work on either side during the process. A dressing tool engages the wheel and dressing is automatic. An automatic sizing attachment can be furnished for full automatic operation; sizing and dressing, as well as movement of the workpieces being completely automatic.

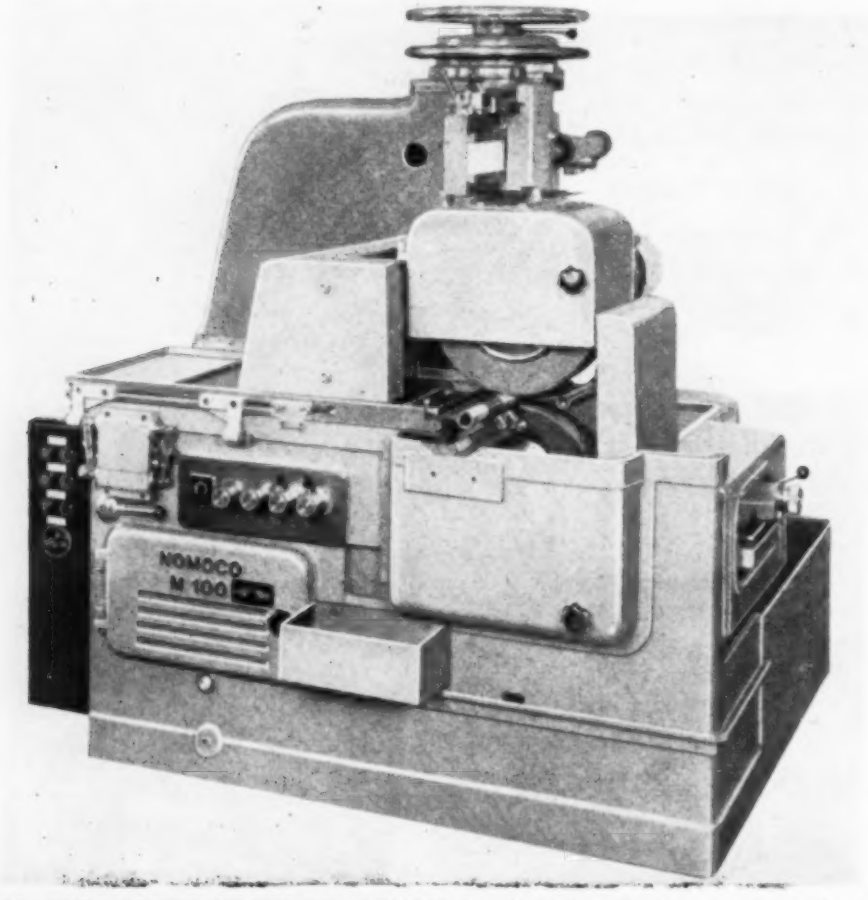
More Two-sided Grinding

Speaking of grinding two sides simultaneously, Emma Schulz, Berlin-Hermsdorf, has a surface grinder with two horizontally opposed spindles to grind both sides of a workpiece. In this case the wheels are cup wheels. Through a special attachment wheel wear is compensated for automatically. The workpiece is introduced between the two wheels by means of a hydraulic movement.

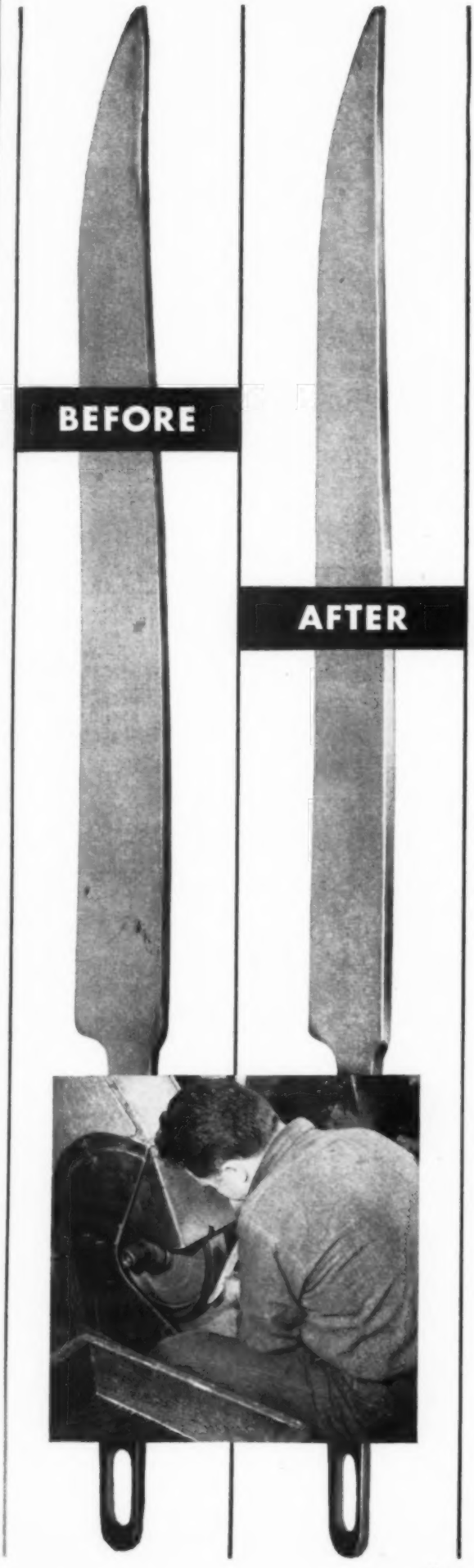
New Centerless Principle

A centerless grinder in which the spindles are horizontally above one another is the Nomoco machine, made by Delisle & Ziegel, Stuttgart, W. Germany. Figure 11 shows the construction of the machine. If memory serves correctly a similar machine was made some 25 or 30 years ago, in the U.S. It is interesting to see it turn up once again.

The manufacturer claims a more consistent roundness of the workpiece and a lessening of the variables found in conventional centerless machines. They further claim a reduction of out-of-round workpieces and less dimensional rejects. Several interesting operations are possible with this construction. For instance, it is possible to arrange two grinding wheels on the same spindle and two opposite regulating wheels, leaving a space between. Parts having two diameters on the end and a hump or a shoulder in the middle can be accommodated by grinding both end diameters while the hump or raised surface falls between the grinding wheels; a typical example is a steering gear cross. • • •



11. THE NOMOCO CENTERLESS GRINDER in which the wheels are mounted horizontally one above the other.



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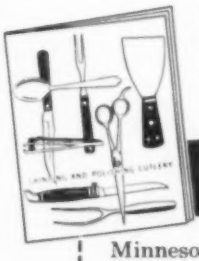

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WRONG: The stand grinder is possibly the most universal of all metal working shop tools. It is used by nearly everyone in the shop, often as posed here. No goggles or face shield. Work rest too far out from wheel. Tool being sharpened held away from work rest.

GRINDING safely

by **Edmund Mottershead,** President
Mottershead Associates, Chicago

DO'S:

1. Let newly mounted wheels run at operating speed with guard in place for at least a minute before grinding.
2. Check at start and periodically during grinding for noise and vibration.
3. Be sure work rest is properly adjusted approximately ⅛" from grinding face and at center of wheel or slightly down.
4. Check maximum operating speed marked on wheel for correct use of the wheel.
5. Always wear goggles with full cups or face shield for face and eye protection.
6. Check condition of wheel, mounting, balance, flanges or blotters to make sure wheel is in good shape and properly mounted.

DON'TS:

1. Never guess about what to do in case of trouble. Shut off the machine and get help.
2. Never dress the wheel without knowing how and without using a proper dressing tool.
3. Don't jam work into the wheel or crowd it. Use moderate, even pressures to avoid straining and cracking the wheel.
4. Never side-grind on a wheel unless it is specifically designed for that purpose. Most side grinding wheels have heavy back-up plates and are balanced and mounted for side grinding pressures.
5. Never use a wheel that has been dropped. Don't force a wheel onto a machine or change the size of the mounting hole. If the wheel won't fit your machine, get one that will.
6. Don't stand directly in front of the wheel when you start it up. Be sure all guards are in place.

RIGHT: Work rest has been moved in to within ⅛ inch of the wheel face. Drill being sharpened is held securely against work rest. Picture at right shows another setup in the toolroom for grinding large drills. Holding fixture has locating pin in center of butt end of drill. Drill lies in V-shaped trough, is rotated slowly by hand while being ground on side-grinding wheel. Entire holding fixture may be swung in an arc to change the angle between drill and wheel face as necessary. Many different sizes of drills can be handled by this one fixture, which enables the operator to keep work in the right position and do the job safely and accurately.

Caught in the middle?

If grinding problems have you caught in the middle and you don't know which way to turn, switch to CINCINNATI (PD)° WHEELS. For *now* CINCINNATI Grinding Wheels offer POSITIVE DUPLICATION—a remarkable achievement in precision manufacturing and quality control than *can save you money . . . and increase your production.*

Here's why you'll stop leading a dog's life when CINCINNATI (PD) WHEELS are on the job: Through the CINCINNATI (PD) Manufacturing Process you are assured Positive Duplication of the original wheel *every* time you reorder. "On grade" with a CINCINNATI (PD) WHEEL means all future (PD) WHEELS will act and grind exactly alike.

Yet CINCINNATI (PD) WHEELS *are priced no higher than ordinary wheels.* So, we think you'll agree it's worth taking a close look at CINCINNATI (PD) WHEELS right away.

Just see your CINCINNATI Grinding Wheels Distributor. He'll be glad to explain how (PD) WHEELS can save you money and increase production. Or, contact us direct and we'll send one of our representatives—men who know grinding and grinding machines as well as grinding wheels. Write, wire or telephone Sales Manager, Cincinnati Milling Products Division, Cincinnati 9, Ohio.

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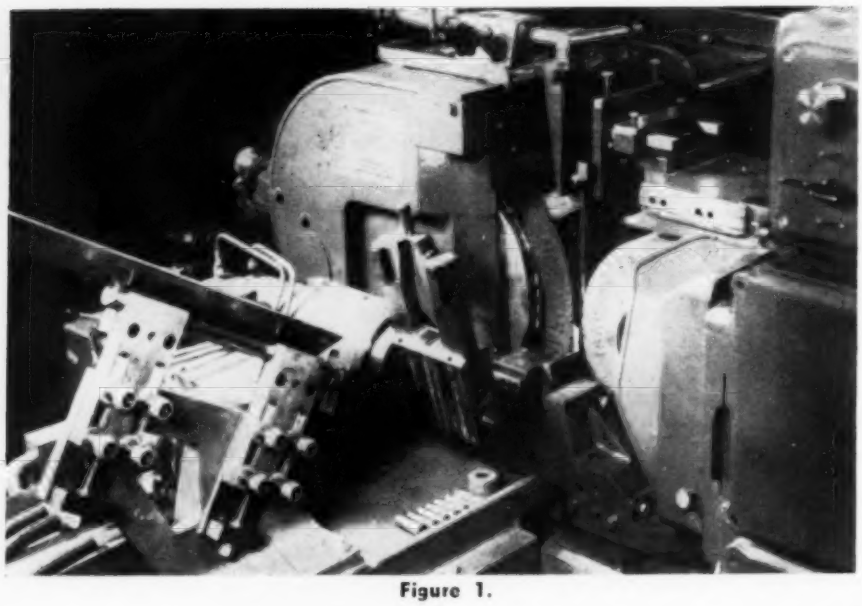

Figure 1.

Automatic Loading

The swingover transfer-finger method used in England has the advantage of versatility. A mere change of the removable jaws enables it to be used for a wide range of workpieces.

Among the numerous methods which have been evolved for the automatic loading of shouldered and similar pieces to the work-plate of a centerless grinder, the swing-over transfer-finger method which is now being considerably used by Arthur Scrivener Ltd., Birmingham, Great Britain, has a number of points of interest. Figure 1 shows this type of loading mechanism applied to a controlled-cycle machine. The action bears a resemblance to that of a human hand selecting a piece from a tray or chute and transferring it to the grinding throat of the machine.

Figure 2 shows how the headed pieces are placed in an inclined workchute and positioned with the heads down, the end of the chute being fitted with a hook stop. From this chute, the end piece is picked up by the spring-loaded transfer fingers which grip the end of the piece, and under the action of the pinion *C* and the fixed rack *B* swing it over to the workplate between the wheels of the centerless machine. As soon as the piece is in position on the workplate, the forward movement of the piston of cylinder *F* and the push rod *D* open the fingers to free the piece, while at the same time the forward movement of cam *E* actuates a limit switch setting in motion the controlled-cycle of the machine which causes the control wheel to close in, thus advancing the piece onto the grinding wheel. While the grinding operation is proceeding, the transfer fingers swing back to the delivery end of the inclined workchute, and when the grinding operation is finished they grip the next piece, while simultaneously the wheels of

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# of Centerless Plunge-Ground Pieces

the machine open again to allow the ground piece to be ejected, thus completing the cycle.

Advantage of the method is its versatility. A mere change of the removable jaws enables it to be used for a wide range of pieces, such as the types shown by Figure 3, all of which present difficulties for loading by a normal push feed. The piece *A*, for instance, has a square shape (diameter and length approximately equal) which is always troublesome to locate or handle automatically; *B* has a head which rules out the possibility of rolling it into the path of a push feed; *C*, a multi-diameter piece, when handled by the swing-over method, is laid on the workplate with the large diameter slightly over the edge of the workplate clear of the wheels, and is fed forward into position by the so-called "plunge-and-run" process of centerless grinding, the piece being fed into position by the pulling action of the tilted control wheel.

On pieces of the types shown, assuming a stock removal of .004-in. and a tolerance for size and roundness of .0002-in. the normal setting is a 10-second cycle.

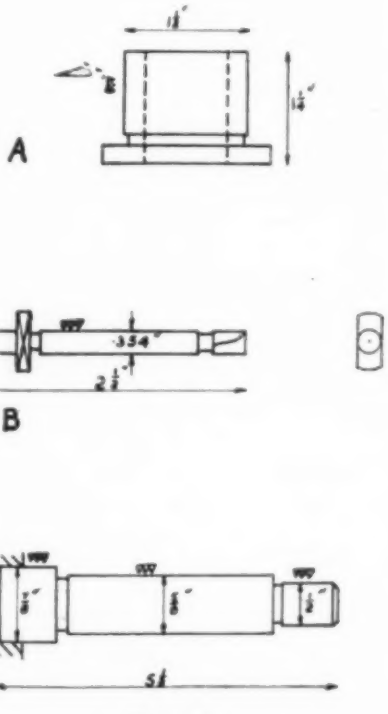

Figure 3.

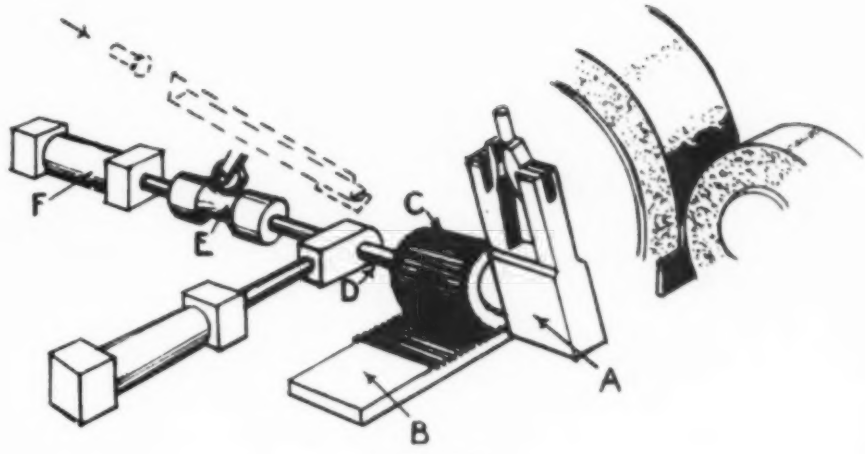

Figure 2.

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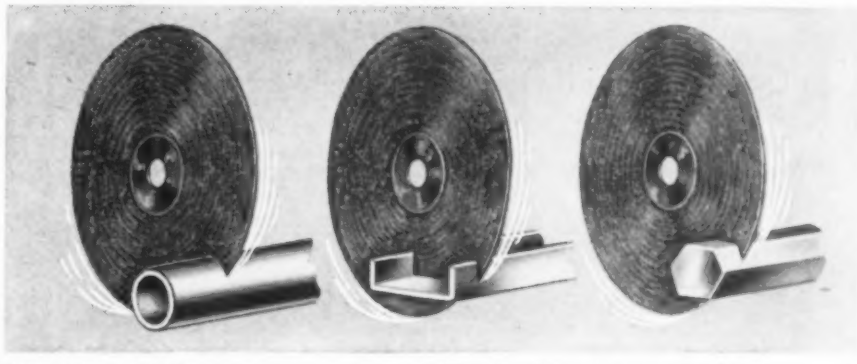

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Diamond Tools and Wheels

The B-56 resin bonded wheel is used for offhand grinding of tungsten carbides and single pointed carbide tips, and rigid grinding for reamers, drills, milling cutters, and all other types of carbide tools. The Al-Aloid Bond has been tested and found to have a fast and consistent grinding action with tremendous length of life. These are just a few of the listings and descriptions of resin and metal bonded diamond impregnated wheels in catalog No. 1056. Properties and characteristics, grading, redressing and grinding speeds of diamond wheels are discussed also.

A.I.T. Diamond Tool Co., 8221 N. Kimball Ave., Skokie, Ill.

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Optical Setting of Wheel Dressing Diamonds

A 4-page bulletin describes technique for optically presetting diamonds for use on contour wheel dressers. It demonstrates how either pre-adjusted single or double diamond holders can be used to eliminate grinder down-time during diamond replacement. Available from Hoglund Engineering & Mfg. Co., 343 Snyder Ave., Berkeley Hts., N.J.

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Arbors and Collet Chucks

Bulletin WA-10 contains dimensional data for the selection of Pope interchangeable extension arbors and tapered shank collet chucks for internal grinding spindles and milling spindles. Two hundred and fifty styles and sizes of arbors are listed and described—each made to precision tolerances, of tough, high grade, heat treated alloy steel, and having the rigidity to support the wheel properly for fast removal of material. It is claimed with these arbors less preliminary wheel dressing is required.

Also described are the new Pope self-removing wheel holders for all types and makes of tool and cutter grinders, vertical, cylindrical and surface grinders.

Pope Machinery Corp., 261 River St., Haverhill, Mass.

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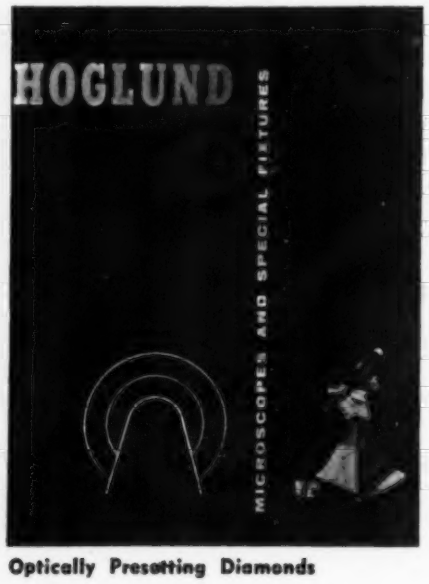
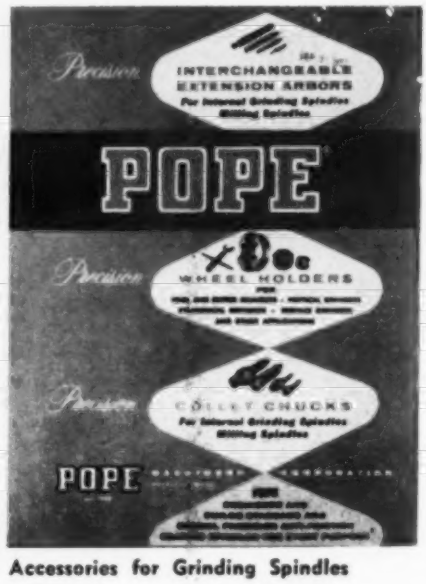
Diamond Tools and Wheels



Optically Presetting Diamonds



Accessories for Grinding Spindles

Arter Rotary Surface Grinders are scientifically designed to provide extremely smooth, remarkably accurate micro-plane surface finishes. The basic feature responsible for these close tolerance, superior finishes is the relation of the grinding wheel to the work. With Arter machines, the grinding is done on the peripheral or outer edge of the wheel while the work is held on a rotating magnetic chuck. This results in extremely fine, concentric finishes so necessary for most component parts used in industry today.

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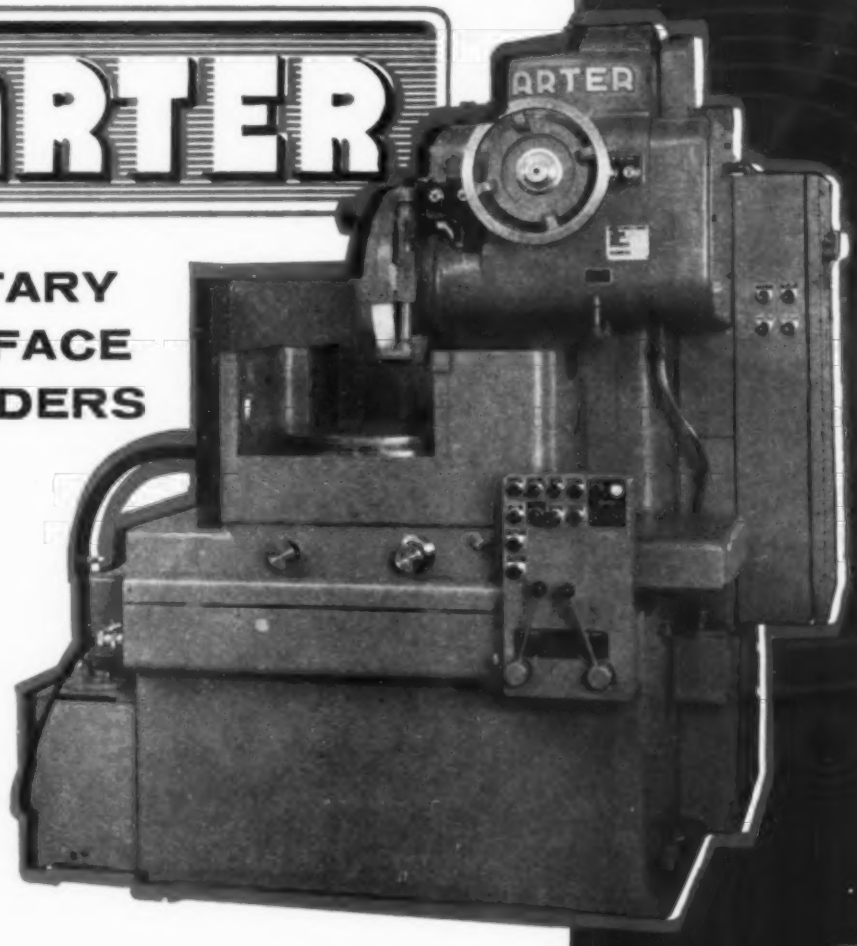
ROTARY SURFACE GRINDERS



Illustrated above is Model E, one of a complete line of Arter Precision Rotary Grinders available in chuck sizes from 8" to 40". Each Arter Grinder features completely automatic grinding cycle . . . building block design for ease of maintenance . . . rigid vibration free construction . . . hydraulic controls . . . variable stepless speeds for both chuck and wheel slide traverse . . . manual and automatic feeds . . . adjustable worktable for concave and convex grinding . . . rotatable magnetic chucks . . . and centralized push-button control panel.

For complete details on Arter Rotary Surface Grinders call your Arter representative or write for free brochure.

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ARTER

ARTER GRINDING MACHINE COMPANY

Manufacturers of
Rotary Surface, Internal, External Grinders and
Arter **JIGMATIC** *Positioning Table*

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REID PRECISION SURFACE GRINDERS REID PRECISION SURFACE GRINDERS REID PRECISION SURFACE GRINDERS REID PRECISION SURFACE GRINDERS

REID PRECISION SURFACE GRINDERS REID PRECISION SURFACE GRINDERS REID PRECISION SURFACE GRINDERS REID PRECISION SURFACE GRINDERS

MODEL 618P
(large illustration)
with dust collector,
and (small illustration) with
wet grinding attachment.

A Complete Line of 618 and 824 Toolroom and Production Grinders

. . . and accessories

REID . . . the quality name in surface grinders! Choose from three different models in the 618 class; capacity 6″ wide, 18″ long, 17¼″ from spindle center to table. Accessories can be supplied for wet grinding, cool grinding, dust collecting, etc.

REID-O-MATIC 824 . . . this fully automatic surface grinder has a capacity of 8″ wide, 24″ long and 21″ from spindle center to table. All-electric controlled — solid construction — available with accessories above.

Get *all* the facts on REID grinders . . . your best buy for toolroom and production economy!

PRECISION REID SURFACE GRINDERS

REID-O-MATIC 824

Bulletins
Write for brochures on the REID 6-18 and REID-O-MATIC 8-24 for complete details

REID BROTHERS COMPANY, Inc.
136 Elliott Street, Beverly, Massachusetts

MANUFACTURERS OF PRECISION GRINDERS AND PRODUCTION LATHES

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Automatic Polishing and Buffing Machines

Catalog No. 50 describe the Hammond strait line automatics designed for each individual application. Both conveyor and heads are built to suit the work to be finished. The many variables permit nearly all work not adaptable to indexing to be finished on a strait line automatic. The new Model K-46-6 super automatic has fast indexing, variable work spindle speeds (15 to 45 rpm) and variable dwell time (1 to 20 seconds).

Hammond Machinery Builders, Inc., 1600 Douglas Ave., Kalamazoo, Mich.

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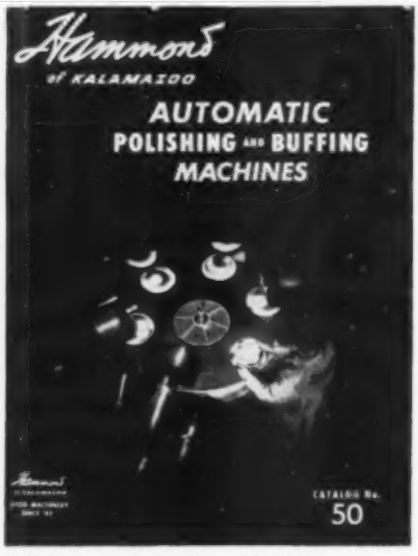

Polishing and Buffing Machines

Rotary Carbide Tools

A 16-page catalog from Fullerton Tool Co., Inc., 121 Perry St., Saginaw, Mich., describes their line of rotary carbide tools. Burs, reamers, end mills, radius mills, and drills are just some of the carbide tools described. Information for ordering these tools is comprehensive. The firm's Nu-Tool Process for reworking carbide rotary files, end mills and similar tools is described. A comparison chart shows tool symbols of major tool manufacturers.

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Angle Plate

Illustrations of the Lassy Master V-block angle plate show the basic reason why this tool can reduce costs while at the same time increase quality and insure high standards of accuracy. Pictured are the two stock models, matched pairs and sine bar. Brochure is available from Lassy Tool Co., Plainville, Conn.

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Profilometer

14-page catalog describes Micrometrical Mfg. Co. profilometer line. Combination of equipment consisting of the QA Amplimeter, V Mototrace, BK Linkarm and LJ Tracer will measure over 85% of all surfaces produced by industry.

Micrometrical Mfg. Co., 345 S. Main St., Ann Arbor, Mich.

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Surface Measurement Equipment

HANCHETT
METAL SAW SHARPENER

for HOT or COLD CIRCULAR SAWS
Solid or Inserted Tooth Types

HEAVY DUTY – BALANCED DESIGN

Straight Line Grinding Wheel Feed Action – Smooth and Accurate

Wheel Head Adjustable for any Saw Tooth Angle Desired (Cam Action)

- Grinding wheel speed is adjustable for wheel wear
- 100% anti friction bearings for smooth, trouble-free operation
- Accurate—simple stroke adjustment for both feed and lift cams
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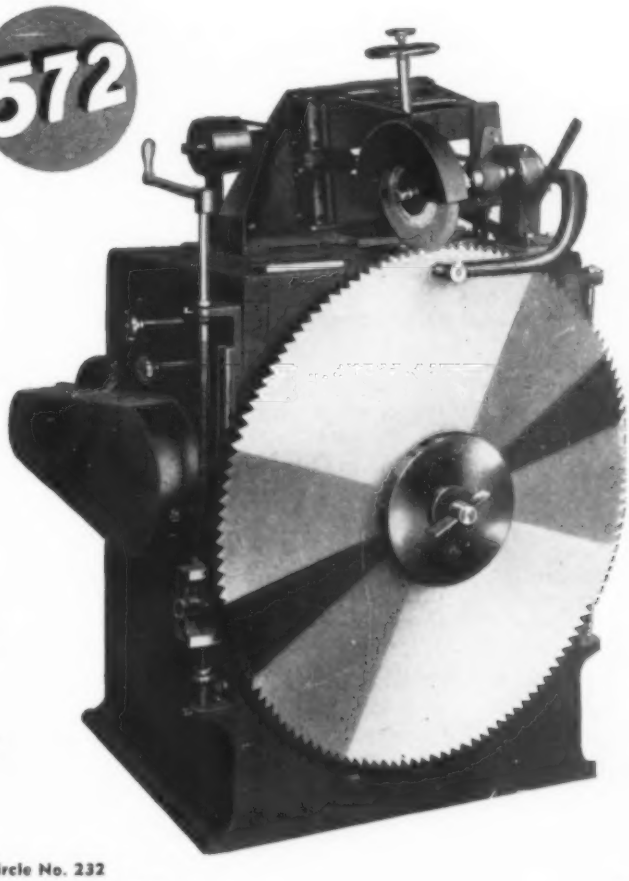
- Heaviest stock removal at high production rate
- Grinding wheel head motor—two h.p. (belted type)
- Capacity—24" to 72" diameter saws (larger when required)
- Available—other sizes and types of machines to meet all saw requirements

MODEL 572



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World's Largest Manufacturers of Saw Sharpening and Knife Grinding Machinery

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JIG GROUND with

Vulcanaire

Provide yourself with this inexpensive* instrument for use on your present equipment and JIG GRIND with a guarantee.

A five station indexing fixture from Vulcan's Contract Tool Room (Your tool room in Dayton).

Using a jig borer index table with the Vulcanaire 5 indexing holes and 35 locating and clamping holes were JIG GROUND in place. Result — eliminated all close locating and dowelling of individual parts and of course hours of time.

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{ Borrow our instructive 11 minute movie on Jig Grinding. }

Services of your Tool Room in Dayton

ENGINEERING • PROCESSING • BUILDING • TOOLS • DIES • SPECIAL MACHINES • VULCANAIRE JIG GRINDERS • MOTORIZED ROTARY TABLES BREHM "SHIMMY" AND RELATED DIES • AUTOMATION

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VULCAN tools

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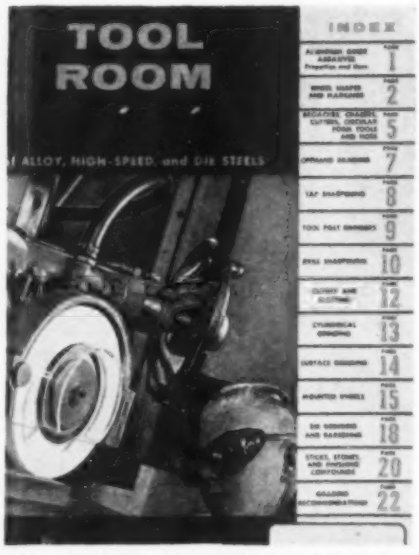
Wheaton, Illinois

Abrasive Products and Techniques

"Tool Room Grinding of Alloy, High-Speed, and Die Steels" is the title of a booklet available from The Carborundum Company, Niagara Falls, New York. Progress in the development of new and improved steels has brought forward many new abrasive products and techniques for proper tool maintenance and other grinding operations performed in the tool room. The pur-



Alloy, High-Speed and Die Steel Grinding

pose of the booklet is to assist the reader in obtaining maximum tool performance through a better understanding of abrasives and how they work.

Use postpaid card. Circle No. 8

Spindles

8-page brochure illustrating and describing the complete line of standard Ex-Cell-O Precision Grinding and Boring Spindles. Many practical applications are shown as are many standard spindles for use as original equipment by machinery builders or as replacement spindles to improve the performance of grinders and boring machines in use.

Write Ex-Cell-O Corporation, 1200 Oakman Blvd., Detroit 32, Mich.

Use postpaid card. Circle No. 9

Pressure Filters

Schematic diagrams of a typical central filtration system and the piping arrangement for pre-coating pressure filters are illustrated in a four-page brochure by U.S. Hoffman. Pre-coat pressure filters for individual machine tools and complete central systems are described in detail.

United States Hoffman Machinery Corporation, 105 Fourth Ave., New York 3, N.Y.

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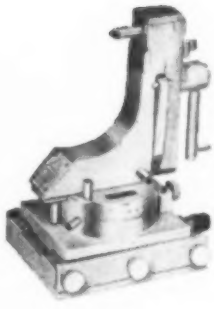
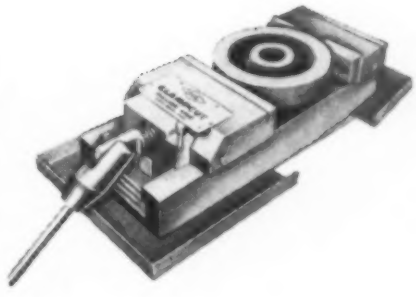
J&S DOWN-HOLDING DEVICES and WHEEL DRESSERS LEAD THE FIELD

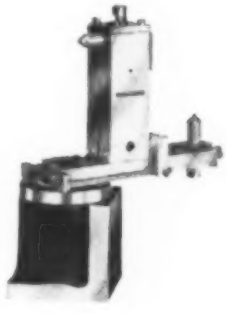


Fluidmotion Wheel Dressers—Dress two angles tangent to a radius, using ONE handle in one continuous motion. Operation is so fast and simple that beginners can use them. For all types cylindrical and surface grinders.



J & S Swivel Vise—The only hardened and ground swivel vise that mounts low, swivels, needs no pedestal. Patented down-holding clamping jaws give many times the holding power of an ordinary vise, yet only half the weight.

J & S All-Purpose Jaw Clamps — For any machine table or face plate. Five models—one adjusting screw has a holding force of 2½ tons on Small model, 12 tons on Jumbo model. Eliminate u-clamps, straps and fingers. No obstruction problems, no interference with measuring tool readings.



J & S Form-Master—Sturdy wheel dresser for shops with less frequent wheel dresser requirements. High quality, 100% dust-proof, it is capable of dressing any radii up to 12″ convex, up to 15″ concave.

Write for free literature and further information.

J&S TOOL CO. INC. — CLAMPCUT

J & S TOOL CO., INC.
880 DORSA STREET
LIVINGSTON, NEW JERSEY

Use postpaid card. Circle No. 234

Automatic Surface Grinders

Two bulletins are available from Blanchard Machine Co. The first, a six-page folder, describes the new Models 80-A, 90-A4 and 100-A5. These models are center column type. Summaries of case histories, specifications, features, fixtures, and controls are reviewed.

The second bulletin covers the complete line of Blanchard automatic surface grinders for work up to 14" in diameter and 12" high. Also included in this four-page bulletin is a brief description of the center column surface grinder which can be supplied with three, four or five grinding wheels.

For copies of these bulletins write Blanchard Machine Co., 64 State St., Cambridge 39, Mass.

Use postpaid card. Circle No. 11

Automatic Surface Grinders

Finishing Overlays of Alloys

Engineering Data Sheet No. 5 from Wall Colmonoy Corp., 19345 John R St., Detroit 3, Mich., lists grinding wheel recommendations for finishing overlays of their hard facing alloys. The data sheet lists in tabular form recommended wheels for use on nickel base, cobalt-base and iron-base alloys. Part numbers are given for wheels of the 11 wheel manufacturers. Recommendations are offered for grinders of the following types: surface (both horizontal and vertical), cylindrical, internal, centerless and tool room.

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Vertical Chucking Grinders

Bullard describes their line of vertical grinders in an 8-page bulletin. The models range from 26" to 76" in capacities. Bulletin includes a schematic with dimensions and descriptions of features.

For copies write The Bullard Company, Bridgeport 2, Conn.

Use postpaid card. Circle No. 13

Coated Abrasives

The listings of the complete line of abrasives are in sections, easily identified for convenience in catalog available. Also included are sheets, belts, rolls, discs and the many specialties developed in recent years for speeding production. Included are listings of resin-sized paper, cloth and combination items, also waterproof cloth, and fibre-backed, resin-bond discs and drum covers. Clover lapping and grinding compounds are covered in a wide range of grits and container sizes.

Clover Mfg. Co., Norwalk, Conn.

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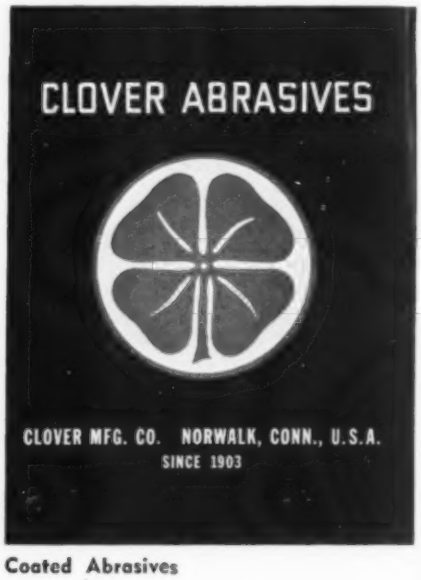


Coated Abrasives

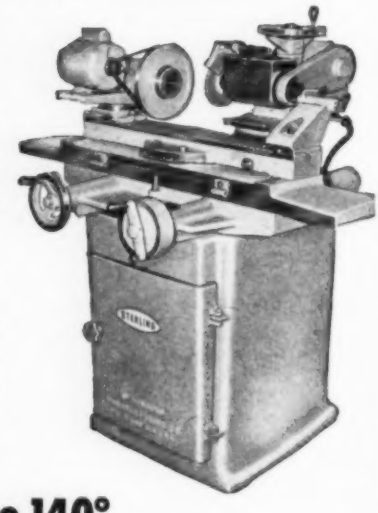
Cylindrical Grinding Wheels

Their complete line of cylindrical grinding wheels is described and illustrated in a four-page, 3-color bulletin now available from Simonds Worden White Company, 1101 Negley Place, Dayton 7, Ohio.

A handy specification table lists thick-

Cylindrical Grinding Wheels

Make accurate set-ups *faster* with this
25° Tilting Spindle



The STERLING Model "G-2" Universal Tool and Cutter Grinder provides this extra feature plus complete versatility and more capacity than comparable machines at *lower cost.*

Swing 10¾" over table, 27" between centers, 18" table travel with 8¼" cross feed. For complete details and specifications write for FREE Bulletin "G-2".

Grind 90° to 140°
Included Angle on *ALL DRILLS*, ⅛" to 2½"

No collets or chucks makes set-ups easy. Clearance gauge insures accurate, positive clearance angle. True conical grinding produces full clearance from center to outside. Write for FREE Bulletin "DV-1".

McDONOUGH MFG. CO.
1522 GALLOWAY • EAU CLAIRE, WISC.

Use postpaid card. Circle No. 235

ness and bore of each of the Dayton safety grinding wheels in stock, for quick delivery. Standard diameters range from 12 to 36 in. In addition, a portion of the bulletin is devoted to practical grinding hints and tips.

Use postpaid card. Circle No. 15

Cylindrical Grinders

A new 16-page catalog is available from the Landis Tool Co., Waynesboro, Pa., describing their 14" and 18" swing plain cylindrical grinding machines. These machines are designed to carry work pieces up to 6500 pounds and are supplied in center lengths from 48" to 168".

The clean functional design includes all of the latest proven advances in hydraulic and electrical control. All these grinders are equipped with exclusive Landis pressure lubricated Microsphere wheel spindle bearings. Other features are hydraulic table traverse, all V-belt drives, built-in coolant reservoir, automatic way lubrication and built-in electrical equipment.

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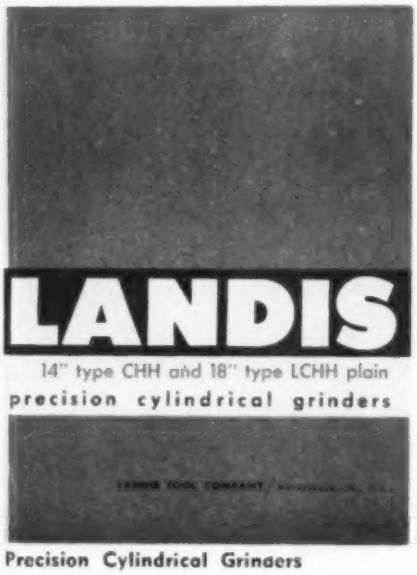

Precision Cylindrical Grinders

Processes and Compounds

The processes for automatically deburring, cutting, smoothing and lustering from the Tumb-L-Matic, Inc., St. Marys St., Stamford, Conn., are the culmination of much research. The bulletin PC-55 available covers processes, compounds and carriers for tumbling metals and plastics as well as other materials.

Use postpaid card. Circle No. 17

Positioning Vise

Literature on the new patented Lassy slide lock instant positioning vise is now available, complete with specifications and prices.

Lassy Tool Co., Plainville, Conn.

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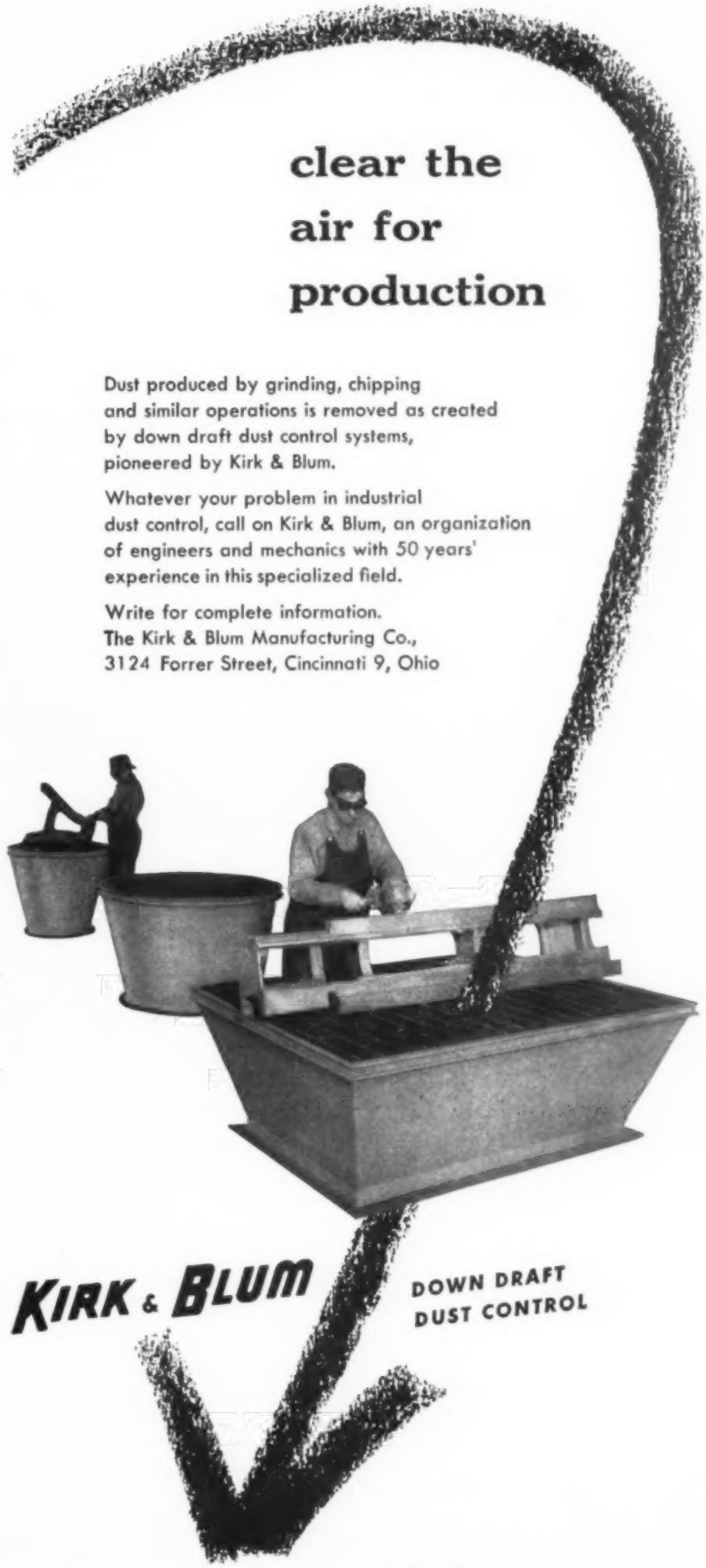
clear the air for production
Dust produced by grinding, chipping and similar operations is removed as created by down draft dust control systems, pioneered by Kirk & Blum.
Whatever your problem in industrial dust control, call on Kirk & Blum, an organization of engineers and mechanics with 50 years' experience in this specialized field.
Write for complete information.
The Kirk & Blum Manufacturing Co.,
3124 Forrer Street, Cincinnati 9, Ohio
KIRK & BLUM
DOWN DRAFT DUST CONTROL

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Contour Wheel Dressers

A 6-page technical brochure from Hoglund Engineering & Mfg. Co., Inc., 343 Snyder Ave., Berkeley Hts., N.J., outlines inclined plane cam mechanisms for dressing grinding wheels with intricate contours. The brochure shows how one or more dressing diamonds can be made to follow steep climb angles by altering feed ratios and contour ratios. Optical setting of the dressing diamond plus inclined plane reduction of precision cams, enables dressing tolerances to .0001". Typical contours are illustrated.

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Soluble Oil

Folder describes the Gulfcut heavy duty soluble oil which is said to increase efficiency of a variety of machining and grinding operations. Its lubricating-cooling-protective properties meet the heavy-duty machining needs. It permits higher speeds, deeper cuts, and offers protection against corrosion. Made with a petro-chemical emulsifier, its applications include heavy hogging cuts, fast fine cuts, boring and grinding of ferrous materials, among others.

Gulf Oil Corporation, Gulf Building, Pittsburgh 30, Pa.

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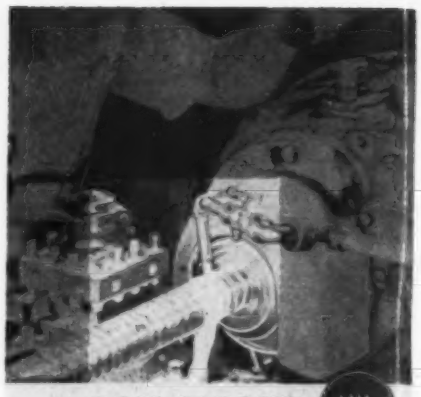

NEW GULFCUT
HEAVY DUTY SOLUBLE OIL
GULF

For heavier cuts . . . at higher speeds . . . with longer tool life . . . even in turning chrome-nickel steels and other tough alloys!

Cutting Fluid

Tumbling Barrels

Bulletin No. LS-55 gives information on the tumbling barrel Type LS (single tumbler) available from Tumb-L-Matic, Inc., St. Marys St., Stamford, Conn. These barrels employ the dry process for cutting down, deburring and finishing metal, plastic, rubber and wood parts. They can be furnished with various drives depending on processing requirements. This Type LS is equipped with overhead drive and protecting channel-iron frame.

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Selecting the Proper Abrasive

In selecting the right abrasive, the following factors should be considered: type of equipment used; type of finish desired on the work; hardness of materials being cleaned, and type of scale or dirt being removed. Discussion of shot peening and more information about the 20th Century persuasive abrasives are included in a new booklet available from the manufacturer.

The Cleveland Metal Abrasive Co., 887 East 67th St., Cleveland 8, Ohio.

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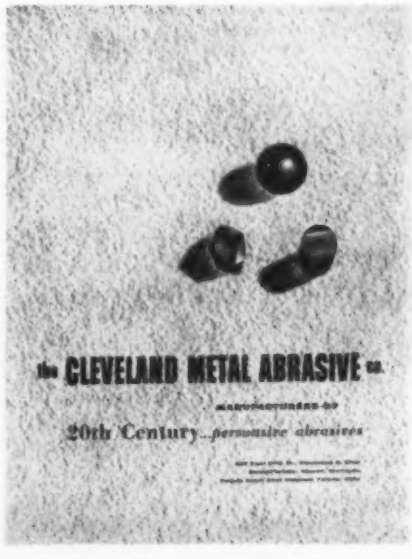

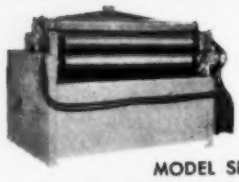

MODEL SPL
24", 36" & 50" belt widths

MODEL TOP
24", 36", 50" & 54" belt widths

Both Models of the Timesaver "Speedbelt" Abrasive Machine can be used in tandem for automatic polishing of tops and bottoms of material being processed . . . in one operation.

Mechanize polishing of aluminum, stainless steel and other metal sheets, bars and blanks—perforated or solid

TIMESAVER SPEEDBELT Abrasive Machines are the fastest and easiest machines to set-up for production polishing schedules on the market today. Abrasive belts with grit range from 40 to 220 can be changed in 5 minutes or less. Adjustment for stock thickness can be made in seconds. Feed speed is variable from 35 to 80 SFM with lower or higher speeds optional. In addition to polishing, Timesaver Machines are used for metal finishing and deburring operations.

Write Today . . . send for the on-the-job story of Timesaver Machines polishing metal grilles and folder describing in detail all the Timesaver features, construction and specifications.

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P.O. BOX 7446 • ROBBINSDALE STATION
MINNEAPOLIS 22, MINNESOTA

Use postpaid card. Circle No. 237

Strange Crystal Growth May Explain Steel Failure, Westinghouse Research Reveals

Crystals, which grow as delicate plates from the surface of stainless steel, may explain, for the first time, a destructive failure of the metal known as "stress-corrosion cracking."

This new theory was revealed by an international authority on corrosion, Dr. Earl A. Gulbransen, advisory chemist at the Westinghouse Research Laboratories in Pittsburgh, Pa. Dr. Gulbransen spoke before the Second World Metallurgical Congress, at the International Amphitheatre, Chicago, under sponsorship of the American Society for Metals.

Stress-corrosion cracking can occur in metal structures which are chemically corroded while under an internal or applied stress, such as a pull or twist. It can cause complete failure of the structure. This cracking can be triggered even by such mildly corrosive substances as steam or human perspiration; and it occurs in objects subjected only to the internal stresses left in them during their manufacture. Stainless steel pipes, turbine blades—even coffee urns and cooking vessels can fail by stress-corrosion cracking.

Working with Dr. Gulbransen in the experiments which led to the new theory were T. P. Copan and Dr. Daniel van Rooyen, research engineers at the Westinghouse Research Laboratories. The experiments are inherently quite simple, but extremely delicate and precise.

In a typical experiment, a small piece of stainless steel wire, nine thousandths of an inch in diameter and subject only to the residual stresses it normally possesses, is exposed to a carefully controlled atmosphere of oxygen and water vapor at a red-hot temperature of 1100 deg. F.

Using very pure oxygen and water vapor, the surface of a typical sample of stainless steel erupts with billions of oxide "whiskers." Only about one or two millionths of an inch in thickness, these whiskers grow to a height 300 or 400 times their diameter. Their density is about six billion per square inch of metal surface.

"Completely unexpected changes occur in this crystal growth simply by prestressing the stainless steel and adding only the slightest trace—less than five parts per million—of chloride ions to the atmosphere," Dr. Gulbransen said.

These oxide whiskers grow on the surface of stainless steel when it is corroded at high temperatures by pure mixtures of water vapor and oxygen. Taken by means of an electron microscope, they are magnified 11,200 times.

Under the electron microscope, these crystals are easily penetrated with a 60,000-volt beam of electrons, placing their thickness at half a millionth of an inch or less. Analysis shows them to have the characteristic structure of an oxide of chromium, Cr_2O_3. Chromium is a metal normally present in stainless steels, and each tiny plate appears to be a single crystal of its oxide. For some time scientists have known that the chloride ion is a major factor in producing stress-corrosion cracking of stainless steel.

"Corrosion in all its forms is a major national problem, costing American industry an estimated $5,500,000,000 annually in replacement costs alone," Dr. Gulbransen added. "Our experiments, we think, are typical of a new approach to this whole problem—an approach which seeks a better understanding of the fundamental mechanisms involved in corrosion.

"Such an understanding, we believe, will only come from carefully controlled experimentation on the atomic scale, not from observations which depend upon massive effects under relatively uncontrolled conditions."

RIBON UNIVERSAL GRINDERS

Electro mechanical and hydraulic models produced by one of Europe's largest grinder manufacturers—completely universal with swinging internal grinding heads. 14" x 2" x 5" O.D. wheel with 3 H.P. and 18000 and 35000 I.D. spindles with 1½ H.P. Long conical adjustable plain bearings in both wheelhead and workhead with automatic pressure oil bath lubrication. All machines have automatic table traverse and infeeds.

11" x 20" Electro Mechanical Grinder ... $3600.00
11" x 32" Electro Mechanical Grinder ... $3775.00
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12" x 28" Hydraulic Plunge Cut Grind... 5430.00

All Prices FOB N.Y. or Chicago

LOW COST GRINDERS

Write for Catalog

CENTRI CENTERLESS GRINDERS

Close tolerance production units capable of .0001" tolerances in production. Long conical adjustable plain bearings on both grinding wheel and feed wheel spindles with pressure oil bath lubrication. Equipped for bar feed, thru feed, and infeed work with automatic ejectors and automatic cycling on infeed where desired. Diamond or crush dressing on both wheels with contour form and taper dressing of wheels by either hand feed screw or hydraulically.

Model 0—Work Dia. .020"-½". 10 x 2¼" x 5" Wheel with 3 H.P. $2250.00
Model 1—Work Dia. 020"-2". 12 x 4 x 5" Wheel with 5 or 7½ H.P. $3450.00
Model 3—Work Dia. .030"-3". 14 x 7 x 5" Wheel with 15 H.P. $5750.00

All Prices FOB N.Y. or Chicago

THE AMERICAN HERFORDER CORP.
1801 W. COLUMBIA AVE. CHICAGO, ILLINOIS

Use postpaid card. Circle No. 238

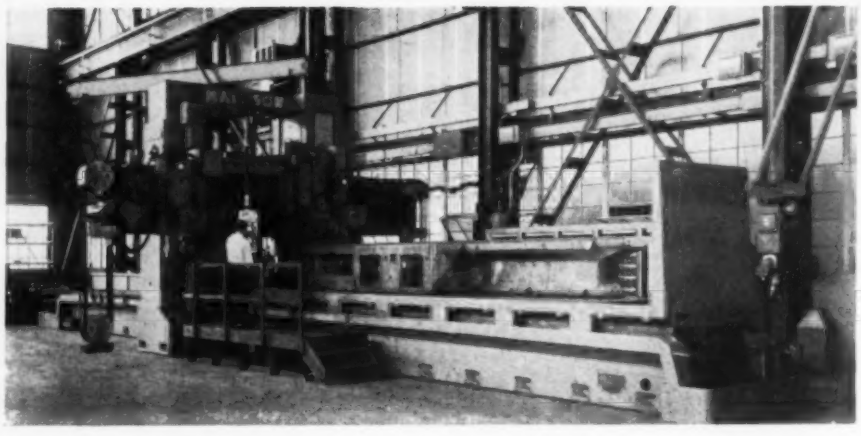
Grinding and Finishing

New Equipment and Materials

For further information on any of the products listed here, use the handy postpaid card opposite page 80.

Dual-Spindle Plano Surface Grinder

A giant surface grinder with two work spindles handles and grinds work up to 80″ wide. Providing two powerful spindle motors enables a variety of surfaces on extremely large work to be handled in a single set up, thereby maintaining exceptional accuracy and precise relative alignment of all work surfaces. There is a 60″ clearance under grinding wheels to the table top.



Both heads are controlled by the operator from the single pendant. An interlock system provides maximum safety in preventing machine and work damage by accidental depressing of a wrong control button. Table always starts in forward direction so that operator always knows direction of movement in advance.

Among the machine controls provided at the pendant are cross-travel of both spindle heads (including reversal points), table speed, feed rate, raising and lowering of rail, inching table forward or reverse, plus stop and start of table reciprocation.

Both hydraulic and mechanical cross feed are provided. Hydraulic power provides both traversing and jump feed in increments from ½″ to 4″. Particularly when the job calls for grinding of shoulders, mechanical micrometer cross feed in increments of .001, .002 or less can also be set at the pendant.

One of the important features of the new grinder is automatic lubrication of all principal moving parts of the machine. Lubrication system for the table is interlocked with the table drive control so the table will not move when the machine is started if the table lubrication system is not operating properly.

To insure continued high degree of accuracy, hardened ways are used on the crossrail. Main support for the crossrail is from the heavy wide ways on the main upright column, insuring accuracy at all points across the full width of the table.

Use of a built-in, direct-drive motor on the vertical spindle permits exceptionally fine finishes to be obtained. Both spindles are provided with 30 hp motors and a 40 hp motor is provided for the table drive.

Weight of this grinder is approximately 250,000 lbs. The base is 57′8″ long, and the table top is 60″ wide by 24′ long.

Mattison Machine Works, 545 Blackhawk Park Ave., Rockford, Ill.

Use postpaid card. Circle No. 101

Orange-Lined Tumbling Barrels

Visibility, ease of cleaning, and wearing qualities are improved with these orange-colored vinyl plastic lined tumbling barrels. The resilient "no-seam" linings provide a smooth, light-reflecting surface for cleaning and inspection.

Available on all Rampe tumbling barrels for new equipment or replacement, the orange linings replace earlier black plastic linings. They are highly resistant to wear and abrasion, oils and most chemicals.

Rampe Mfg. Co., 14915 Woodworth Ave., Cleveland 10, Ohio.

Use postpaid card. Circle No. 102

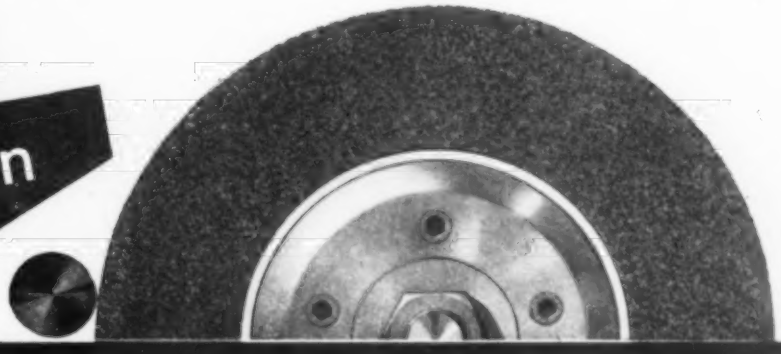
RAMPE TUMBLING BARRELS. Orange linings replace black.

WALTHAM "Variable Density"

CYLINDRICAL GRINDING WHEELS

Reduce Cylindrical Grinding Costs

PRODUCE UNIFORM Grinding Action



ALL THE WAY TO THE FLANGES

DRESSING

All the way to the flanges—more pieces per dress as Variable Density **grinding action is uniform all the way down.**

CORNERS

Uniform action all the way to the flanges — sharp corner holding, as Variable Density adjusts for changing contact area.

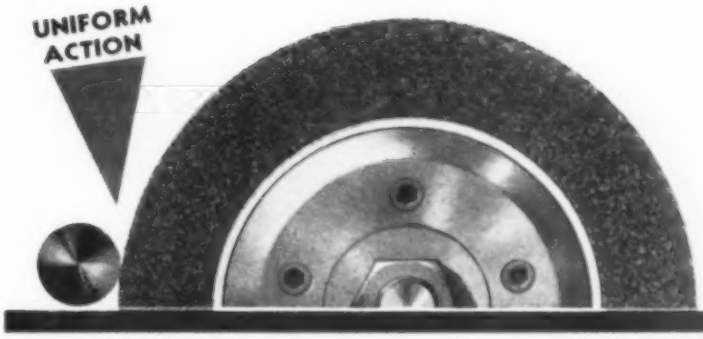
FINISH

Uniform micro-inch readings all the way down to the flanges.

•

Many grinding departments have found Waltham 14A602-K17V2 an exceptionally good wheel for Cylindrical Grinding. Note: 17 indicates Variable Density with 7 structure.

Waltham Variable Density Wheels are made from 16" through 36" as operations require.

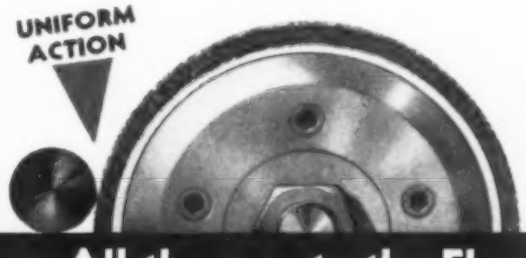


As Grinding Wheels Wear Down the constantly smaller diameter creates two changes in grinding action—

the surface feet per minute gradually become lower,

the arc of contact between wheel and work gradually becomes smaller.

Waltham Variable Density automatically compensates for these ordinary wheel conditions, with uniform action all the way to the flanges.



Yes—All the way to the Flanges!

Waltham Grinding Wheel Company • ESTABLISHED 1880 WALTHAM, MASSACHUSETTS

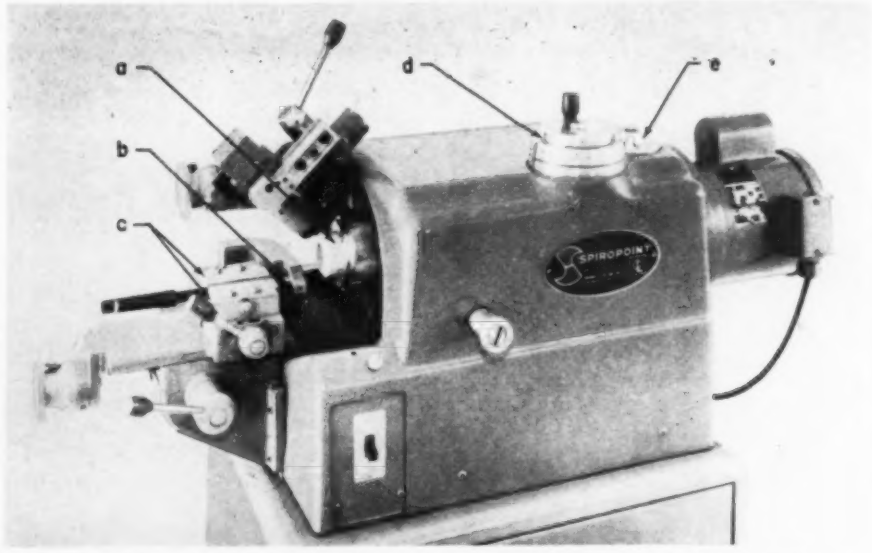
Cincinnati Introduces Machine For Grinding Spiral Point Drills

The recently announced spiral drill by Cincinnati Lathe and Tool Co. which reduces the negative rake angle common to the chisel point drills, presents the need for additional grinding equipment.

The spiral point drill differs from the chisel point in that the cutting edges and point form a curve or spiral rather than the straight or chisel edge of the common drill. This curve, therefore, must be generated in specially designed grinding machines.

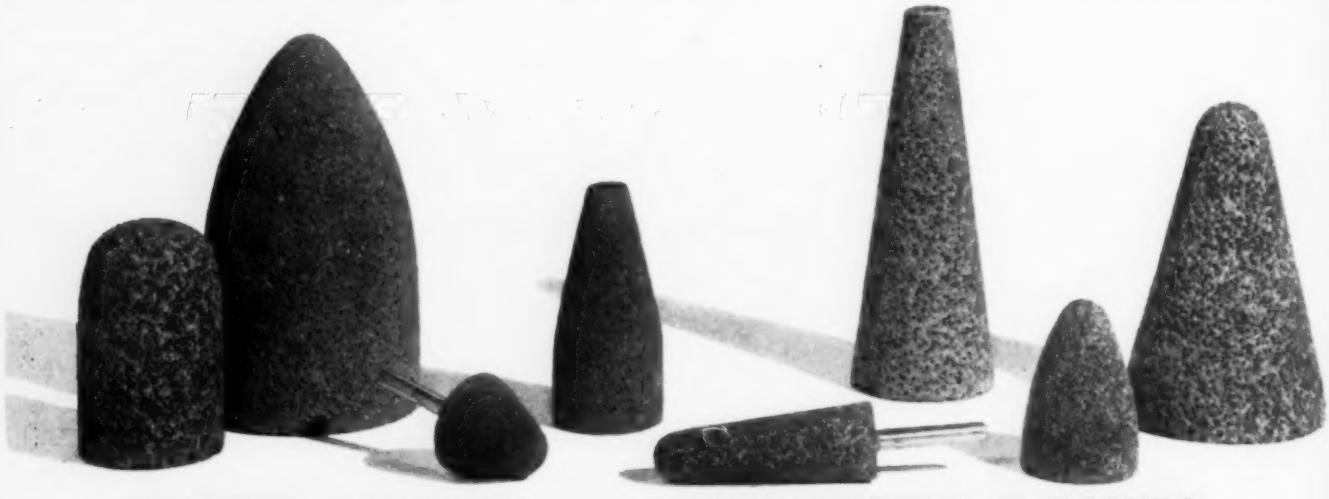
The Spiropoint drill sharpener is designed so that the drill is clamped in place while the generating system gyrates around it. A retractable control bushing orients the drill for clamping. The small tubular grinding wheel is mounted in a rotatable carrier. This carrier is so arranged that the desired shape is generated in the end of the drill as the grinding wheel gyrates around the drill axis.

During the operation the drill is advanced, engaging the continuously gyrating grinding wheel until the desired amount of stock has been removed.



The Spiropoint drill sharpener consists of (a) small tubular grinding wheel, (b) retractable control bushing, (c) clamp, (d) adjustable dial-indicator and (e) a second adjustable dial for special requirements.

An adjustable truing device is provided for the grinding wheel so that the point angle of the drill may be varied from about 90° to 180°. A simple dial-indicator adjustment provides the correct combination of radial and axial motions for the desired size of drill. A second adjustable dial allows for values of relief above or below the standard amount. •



CONES, PLUGS and MOUNTED POINTS

These new "X" type specials are designed for those "HARD TO GET AT" jobs. They are tougher, last longer, cut faster. Another member of Precision's "X" family of improved resin products. TRY them — then BUY them.

PRECISION

PRECISION GRINDING WHEEL COMPANY

PHILADELPHIA 36, PENNSYLVANIA

Use postpaid card. Circle No. 240

Johnson's major contribution to coolants fits today's high-speed production needs!

Coolants were just coolants for 50 years until Johnson's Wax Research developed formulations using *waxes* and *wax-type synthetics*. Johnson's Metalworking Fluids are as modern and efficient as your 1957 machine tools. They give you superior performance even on your toughest jobs — because Johnson's lubricates and cools under conditions where ordinary coolants fail because of extreme heat and pressure.

Use Johnson's on your fastest machines, with your hardest-to-machine metals, and compare results obtained with conventional coolants. In hundreds of shops across the country, Johnson's coolants for machining, cutting and grinding are reducing costs and increasing profits.

Your local Johnson's industrial distributor will be glad to set up an in-your-shop test of TL-131 — or any of the complete line of Johnson's Metalworking Fluids. Ask him about Johnson's money-back *Guarantee of Superior Performance* over ordinary coolants.

from
Johnson's Wax Research

S. C. Johnson & Son, Inc., Industrial Products Division, Dept. D-57, Racine, Wisconsin

"Johnson's" is a trademark of S. C. Johnson & Son, Inc.

Pictured below is Johnson's TL-131, one of a complete line of modern coolants for today's high-speed grinding.

new liquid sizing

automatically gauges full length of honed bores

Coolant flow is through the orifices in the honing tool. By incorporating liquid sizing on the tooling, brackets used with other types of sizing have been eliminated.

BarnesdriL honing engineers have developed an improved method for sizing honed bores, as a part of the honing machine cycle. Referred to as Liquid Sizing, this method automatically gauges the diameter of honed bores throughout their full length as honing progresses.

Sizing is accomplished by metering liquid pressure, directed against the cylinder wall through orifices in the honing tool. As honing progresses, the bore increases in size, causing the pressure to decrease. When the pre-selected bore size is indicated over full length of honed bore by the balanced pressure, a limit switch terminates the honing machine cycle, permitting the tool to complete the stroke and withdraw from the bore.

This new BarnesdriL Liquid Sizing method offers the following advantages:

1. Sizing the entire length of bore.
2. Better heat control as a result of directing the flow of coolant through the honing tool orifices to the most critical point.
3. Continual stone flushing, giving longer stone life and better micro finish control.
4. New BarnesdriL Plate Type Honing Tools are utilized.

Contact your BarnesdriL representative for full details on new Liquid Sizing, or write us directly. Years of engineering experience dealing with honing problems enable BarnesdriL engineers to supply the most practical methods and equipment to solve your hole finishing problems.

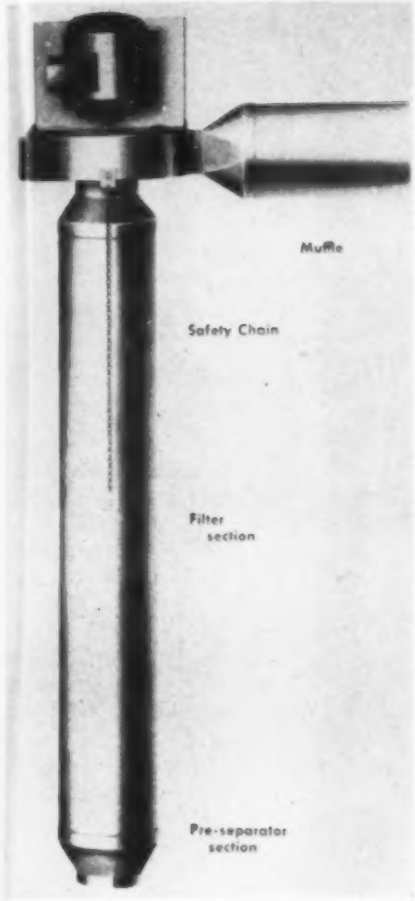
CUSTOM-HONING SERVICE for special short-run applications. Send us your short-run pieces, with specifications and requirements for prompt honing by expert technicians.

50th year

BARNES DRILL CO.

886 CHESTNUT STREET • ROCKFORD, ILLINOIS
DETROIT OFFICE: 3419 South Telegraph Road

Use postpaid card. Circle No. 302



Mist Separator Is in a Pipe

Designed for installation overhead to save floor space, the "pipe type" collector, known as Mistender, uses a slightly larger-than-usual pipe to enclose a filter that is especially adapted for separating mist from the air stream and returning it to the source as reusable condensate. The pre-separator causes most of the mist, as well as the solids, to "throw-out" and also be removed as condensate through contact with the inside surface of the pipe. A considerable volume of solids, fog, and mist, it is claimed, is removed in this way, never touches the filter, and thereby prolongs its life.

To save heat the cleaned air is usually returned to the working space; an acoustically lined muffle subdues air noise. However, exhaust to the outdoors when required by reason of noxious fumes is by means of standard sheet metal pipe which replaces the muffle —no special adapters or enclosures being required.

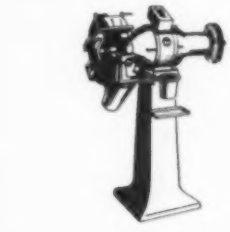
Model M-5 illustrated with continuous duty 1/3 hp motor driving high efficiency fan has a rated capacity of over 500 cfm and is recommended for collecting mist and fog from small tap, centerless and thread grinders, screw machines as well as for surface grinders employing coolants.

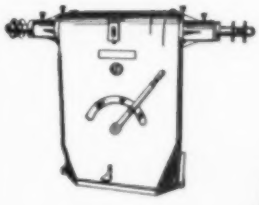
Dustender Co., 3642 Pontiac Rd., Ann Arbor, Mich.

Use postpaid card. Circle No. 105

GRINDERS . . . BUFFERS

BUFFERS— Direct, Belt, gear, vari-speed





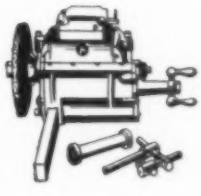
These superb electrical grinders and buffers . . . 1/3 to 40 hp . . . set the pace for highest quality and efficiency . . . and for amazing savings in cost and maintenance. Preferred by industry everywhere!

ATTRACTIVELY PRICED

United States Electrical Tools

Over 60 years of Service to Industry

GRINDERS— Lathe, tool post, angle plate, vertical spindle



GRINDERS . . .

Direct, gear, belt drive, swing frame, vari-speed single or dual motor, portable, bench, angle plate, die, wet, disc and snagging grinders; combination grinder and buffer.

BUFFERS

Direct, belt, gear, vari-speed buffers.

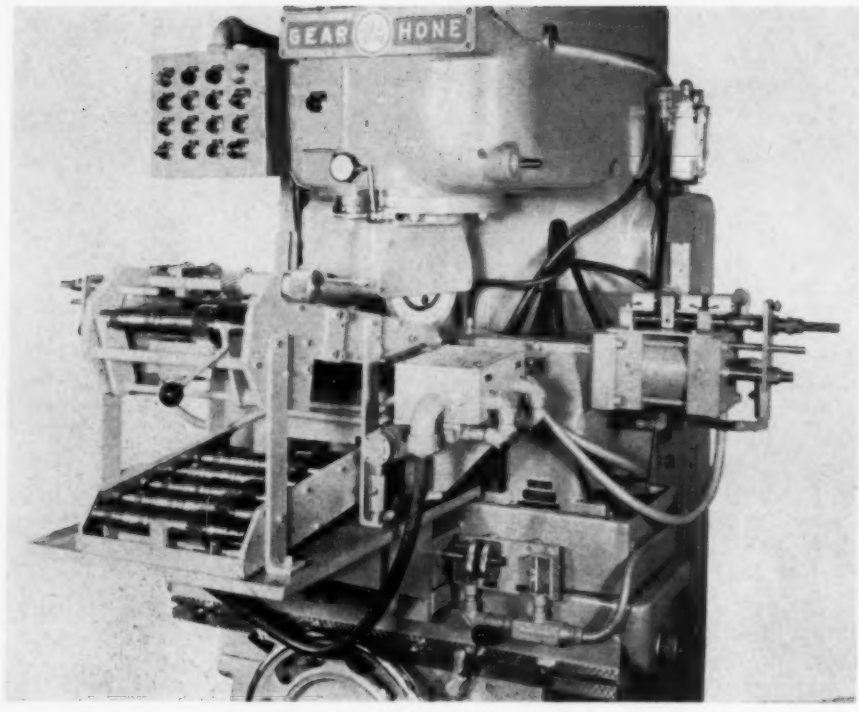
United States Electrical Tools are electrically and mechanically correct.

ALL ROTATING PARTS AND SPINDLES ARE PRECISION-BALANCED DYNAMICALLY BY LATEST ELECTRONIC EQUIPMENT

WRITE FOR CATALOGS

The United States Electrical Tool Co.
3640 LLEWELLYN ST., CINCINNATI 23, OHIO

Use postpaid card. Circle No. 241



Automatic Loader Speeds Honing Operations

A Red Ring automatic loader for handling long-shaft, unsymmetrical gears on both gear tooth honing machines and rotary gear shaving machines has a built-in gaging device, magazine feed, air-powered rocker-type loading mechanism and a discharge chute that feeds finish-honed parts to unloading position in front of operator.

An assembly of lever-type grip fingers in both input magazine and discharge chute keeps the gears from touching each other and avoids the cocking of parts that can result from the effect of the greater weight of one end of an unsymmetrical, long-shaft gear.

The rocker-type unloader mechanism is a simplified design that requires minimum maintenance and is practically unaffected by chip conditions. Operation of the loader is entirely automatic when used in conjunction with standard gear tooth honing machines or rotary gear shaving machines equipped with suitable controls and air-powered head and tailstocks.

The operator fills the input magazine with long-shaft gears and presses the cycle start button. The rocker mechanism picks up a gear at the end of the magazine and rolls it into mesh with the honing tool. In the event that meshing is made incorrectly, the rocker automatically retracts and remeshes the gear with the honing tool. While the gear is being honed, the rocker retracts to loading position where another gear drops into position. When the gear is honed, it is automatically unloaded by the rocker mechanism, and the next gear is rolled into mesh with the honing tool.

Oversized gears are rejected automatically before entering the input magazine. Oversized work gears will not pass between the gaging gears in this magazine. The lever-type fingers in the input magazine and discharge chute pivot as each gear passes over them. Weight of a gear causes individual levers at each shaft end to rock down, thus raising the ends of the levers, which act as stops for the following gear.

National Broach & Machine Co., 5600 St. Jean Ave., Detroit 13, Mich.

Use postpaid card. Circle No. 106

Industrial Cutters Provide Long Life

New Johnston-milled Huntington style cutters are milled, not punched, of extra high carbon alloy steel. Heavy, wide cutter teeth provide more steel in each tooth, resulting in extra life plus steel that is hardened all the way through each cutter section.

The cutters are available in No. "0" —1¼" diameter, No. 1, 1½" diameter and No. 2, 2⅜" diameter.

Machine Products Corp., 125 Hollier St., Dayton 3, Ohio.

Use postpaid card. Circle No. 107

The **FORM-ALL**

UNIVERSAL ANGLE-TANGENT-TO-RADIUS WHEEL DRESSER FOR SURFACE AND CYLINDRICAL GRINDERS

SEE WHAT THE FORM-ALL HAS THAT OTHERS DON'T:

Features	Form-All Geometric	Geometric Dresser "A"	Geometric Dresser "B"
1. Automatic self-centering	YES	YES	NO
2. Selective centering	YES	NO	YES
3. 2 angles tangent to radius, dressing automatically	YES	YES	NO
4. Micrometer setting of diamond	YES	YES	NO
5. Straight line angle dressing	YES	NO	YES
6. Spring-loaded gib for angular dressing	YES	NO	NO
7. Chatter-free even on hard wheels	YES	NO	NO
8. Angular motion is straight with no looseness in gibs	YES	NO	YES
9. Vernier for angular settings	YES	YES	YES
10. 1 minute micrometer adjustment for angular settings	YES	NO	NO
11. 3" straight line angle dressing without stoping at center	YES	NO	YES
12. Position dresser against any one of the 4 sides to dress 180° radii.	YES	NO	NO

Prices: $500 including diamond and instrument case F.O.B. East Orange, N.J.

OTHER FORM-ALL PRODUCTS:

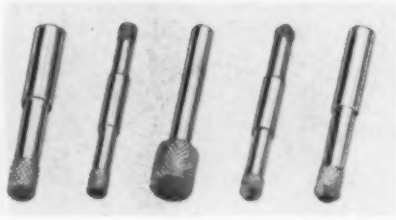
Contour Rex Template Dresser and Rectifier. The simplest and most accurate dresser of its kind.
Form-All Relief Fixture. Designed to grind form reliefs in milling machine cutters.
Form-All Cutter Sharpener. A fixture for sharpening spiral end mills, left or right hand.

FORM-ALL MANUFACTURING COMPANY

Providing "The Engineering Service for ALL Form Grinding"

364 Glenwood Avenue — East Orange 2, New Jersey

Use postpaid card. Circle No. 242



Tool Life Increased Up to 1,000%

The Raymac Div. of Dexco Corporation was one of the first manufacturers of solid carbide grinding tools and has continued improving these tools through engineering research and study of application problems. Experimental work was conducted to determine maximum efficiency and limitations of these solid carbide grinding tools.

After research Dexco came up with practical solid carbide internal grinding tools designed for high speed operation to remove stock speedily without loading, less heat and no dressing. These Raymac solid carbide tools, operating at speeds of 2,000 to 3,000 sfpm, are adaptable to most jig and standard internal grinders.

Increased production in the finishing of internal surfaces of tools, dies, gages, bushings and other hardened metals has been made possible, with good performance on plastics, ferrous and nonferrous metals. In many cases tool life has increased up to 1,000%.

Raymac Div., Dexco Corp., 15490 Dale Ave., Detroit 23, Mich.

Use postpaid card. Circle No. 108

Grinding Wheel

The invention of a different kind of porous grinding wheel utilizes minute balloon-like particles or brittle sponge-like rigid materials that break away to form "air conditioned" voids in the cutting surface when the wheel is in use. Patent was awarded to Norman P. Robie, assistant research director, and assigned to the company.

This wheel makes possible better control of pore uniformity in denser hot pressed resin bonded snagging wheels. More porous cool cutting wheels and segments can be manufactured. In this case, the balloon-like particles act as pore supports to prevent slumping during the melting of the resin bond prior to hardening in the bake ovens. With the new type wheel, a wide range of structures is possible with uniformity.

Electro Refractories & Abrasives Corp., 344 Delaware Ave., Buffalo 2, New York.

Use postpaid card. Circle No. 109

DALZEN

2 in 1 COMBINATION
CENTER GRINDER & DRILL PRESS

A drill press and center lapping machine at less than the cost of many single purpose center grinders! In addition to savings on equipment costs, the Dalzen "2 in 1" permits maximum man-hour production thereby keeping your unit cost at a minimum!

1 SIMPLE OPERATION CHANGES CENTER GRINDER TO DRILL PRESS

Center grinder to drill press or drill press to center grinder in a matter of seconds! Simply unlock clamping handle and swing diamond dresser in or out of position! Photo at left shows center grinder in dressing position. Photo above shows center grinder at work.

A full 43" capacity from base to spindle . . . dresser adjustment from 20° to 100° included angle . . . drills to center of 15" circle . . . maximum lapping stone dia. 3".

THREAD GRINDER

Average Set-Up Time 30 Minutes! Saves Floor Space! Low Cost!

Excellent for tool room and production Thread Grinding. Easily set-up from job to job! Has built-in relieving attachment as standard equipment for grinding of taps. This remarkable machine may also be used to grind angles, grooves and surfaces where concentricity is an important factor!

Dresser and wheel head are self-compensating. Size of work is automatically maintained after dressing of wheel regardless of how much is dressed off.

The grinding and regrinding of thread rills up to 3" in diameter and thread milling cutters can also be ground with special attachment.

WE ALSO SPECIALIZE IN THREAD ROLLING DIES AND THREAD HOBS
LITERATURE ON REQUEST

DALZEN MANUFACTURING CO.
4600 BREE ROAD, DEPT. GF-12
ST. CLAIR, MICHIGAN

Use postpaid card. Circle No. 243

DESSAU

EXPANDED FACILITIES

FOR RESEARCH AND MANUFACTURING

The Finest Diamond Tools Produced . . . Anywhere

Our new plant—three times larger than our former one—houses the country's finest and most complete facilities for the production of diamond tools and diamond wheels. Our staff of highly skilled diamond cutters and diamond setters work in a pattern of continuing research in order to develop ever better products for our customers. For four generations—over 117 years—the name Dessau has been synonymous with progress. Most important, Dessau Diamond Products score a record of success in the world's largest and most renowned industrial plants. We have solved industrial diamond problems for outstanding industries—everywhere.

Whatever your industrial diamond requirements, you can find the answer in our latest illustrated catalogs, **"Diamond Tools"** and **"Diamond Wheels"** and in our new illustrated booklet, **"Diamonds Are A Grinder's Best Friend"**.

Write for these catalogs today. They are available on request.

Maurice S. Dessau Co. Inc.

Since 1841

Manufacturers of DIAMOND TOOLS and DIAMOND WHEELS

589 Fifth Avenue, New York 17, N. Y. • Tel.: PL 9-3434

"DESSAU Diamonds True the Wheels of Industry"

Offices from Coast to Coast

Use postpaid card. Circle No. 244

KENGRIT, TUNGSTEN CARBIDE MATERIAL, will not round off or break when applied to metallic surfaces. The fine, sharp grits of carbide have proved of lasting quality in use on tools for sanding and finishing wood, plastics and other materials. Kengrit is produced by Kennametal, Inc., Latrobe, Pa.

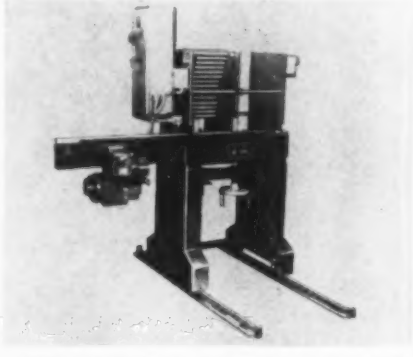
Use postpaid card. Circle No. 119

Magazine Loader

The new Model 8000 magazine loader is a completely self-contained unit ready for immediate installation at the machine to be fed. Parts are loaded into the unit's large capacity hopper, from which they are cycled by an automatic switch, escapement and agitator mechanism, to a steel conveyor belt which, in turn, delivers the parts to the production machine. This machine was designed for feeding long bars or tubing into centerless grinders, polishing machines and other operations where parts are fed automatically in end-to-end position.

The magazine hopper is fully adjustable to permit handling parts ¼" to 2¼" in diameter, 3" to 24" in length, and permits loading up to 2,200 ¼" diameter pieces.

The conveyor is powered by a ¼ H.P. motor and is provided with a variable speed drive which controls cycling rate and permits conveyor speeds ranging from 5 to 20 feet per minute.



The magazine and conveyor height are fully adjustable by means of a hand wheel conveniently located in the front of the machine. Added flexibility is provided by the "V" track mounting of the unit which facilitates lining up the loader with the production machine.

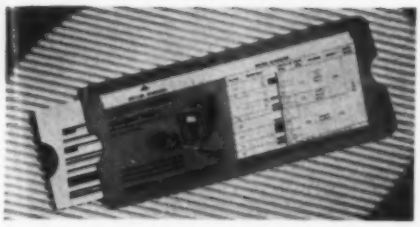
Production Feeders Corp., 3130 Johnnycake Ridge Rd., Mentor, Ohio.

Use postpaid card. Circle No. 110

Profilometer Slide Chart

This chart for business and industry provides a quick, accurate means of determining the right machining operation to use in getting a desired microinch finish. Typical applications and tolerances are also given on the same side of the chart.

The other side of the chart serves



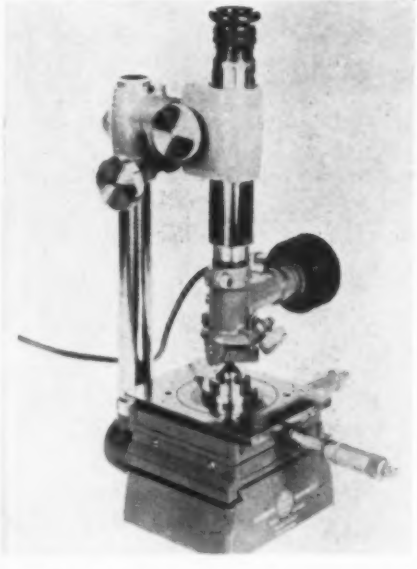
as a compact set of operating instructions. By setting the arrow on the ID or OD to be measured, the chart will tell the inspector, quality control man or engineer the proper combination of profilometer equipment to use.

Copies of this chart may be had by writing on company letterhead to Micrometrical Mfg. Co., 345 South Main St., Ann Arbor, Mich.

Use postpaid card. Circle No. 111

Microscope Measures Surface Roughness to One Millionth Inch

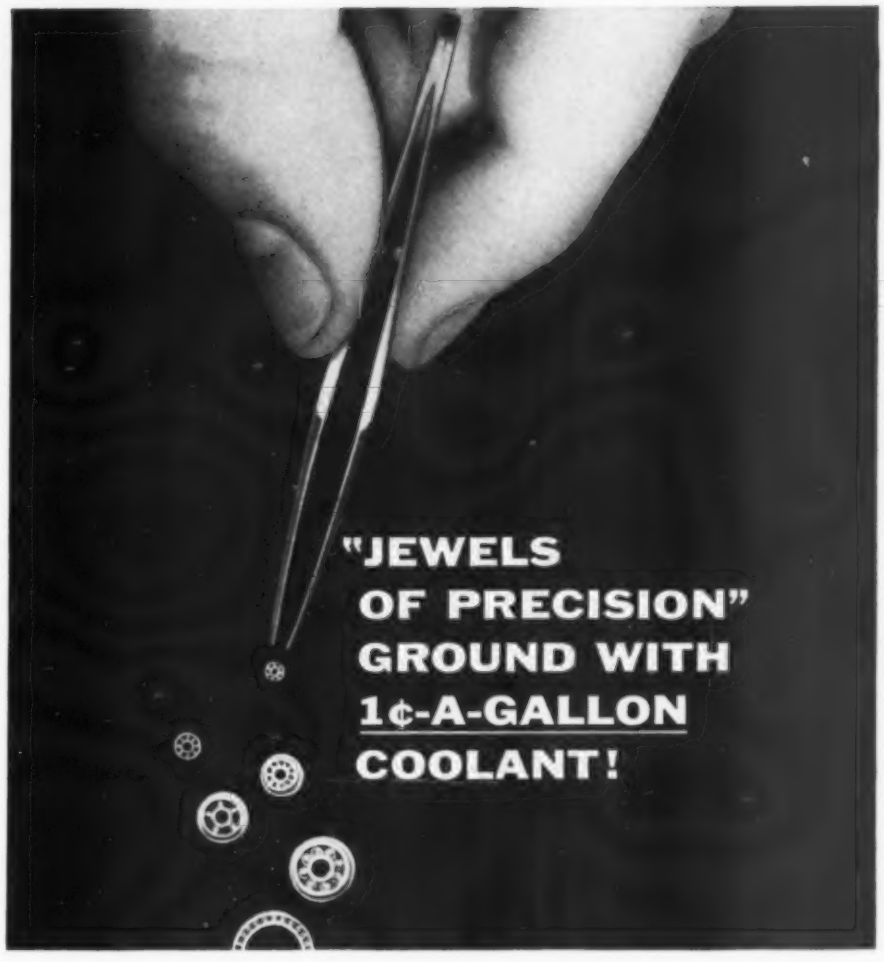
With the surface finish microscope, roughness of flat or curved surfaces can be measured directly to an accuracy of .000001 in. without calculations or use of tables. The image of the surface under examination is magnified 125 times and the readings in depth are made through fringe spacing of the contour lines. An easily adjusted camera attachment makes photographic records on 35 mm. film. By using interference fringes, this microscope permits checking of surface finish in terms of wave length of light.



The instrument is of exceptional valve in checking surface finish of such products as piston rings, ball bearings, ball races, injection molds, razor blade edges, and can be used by unskilled personnel after a few minutes' instruction.

Engis Equipment Co., 431 S. Dearborn St., Chicago 5, Ill. •

Use postpaid card. Circle No. 112



"We feel that White and Bagley 1500 is the best grinding liquid we have found!"

— Miniature Precision Bearings, Inc.

Machining of ball bearing assemblies so tiny that 500 can fit in a thimble is everyday routine at Miniature Precision Bearings, Inc., Keene, N. H. For such exacting work as precision grinding of tiny bearing races, W&B Grinding Concentrate 1500 is specified.

This entirely different type of coolant is normally diluted 1 part concentrate to 150 to 200 parts water. A 55-gallon drum of W&B 1500 provides up to 11,000 gallons of coolant — *at a cost of only 1¢ a gallon!*

Coolant made with W&B 1500 is transparent, and foamless as water. It provides excellent rust protection. Grinding is keener . . . machines stay cleaner. Chips settle almost instantly.

Mail the coupon for complete information about this outstanding coolant concentrate, being used by many of the country's largest manufacturers.

W&B INDUSTRIAL LUBRICANTS

THE WHITE & BAGLEY CO.
Worcester, Massachusetts • Detroit, Michigan
Originators of Grinding Lubricants

THE WHITE & BAGLEY CO., 88 Foster St., Worcester, Mass.
Please send me complete information on W&B Grinding Concentrate 1500.

NAME ..... TITLE .....
COMPANY ..... STREET .....
CITY ..... ZONE ..... STATE .....

☐ My plant has a tricky grinding problem on which we'd like advice. I've attached a letter describing it in detail. I understand that you offer this service without obligation.

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Free Maintenance Kit for Gage Block Care

To help users increase the life of their gage blocks, The DoAll Company now supplies the necessary tools for gage block maintenance with each gage block set of 38 pieces or larger.

The complete kit consists of a black granite-diorite deburring stone, a camel's hair brush, insulated forceps, a large box of lint-free "wipes", two informative booklets and two Aerosol type liquid containers with specially compounded liquids for gage block care. One of them is DoAll gage block preservative and the other is DoAll gage block cleaner.

Gage blocks often pick up microscopic burrs. The manufacturer has taken steps to eliminate the cause by "burr proofing" the edges of all of their blocks. The black granite-diorite deburring stone is included in the kit to permit the removal of burrs without injury to gage blocks.

DoAll Company, Des Plaines, Ill.

Use postpaid card. Circle No. 113

Contact Wheel Simplifies Metal Grinding

Known as the R-58, a rubber contact wheel is outstanding for ability to shape itself to contours of object being ground. Because of its deep serrations the wheel will even conform to difficult shapes as boat propellers, intricate automobile hardware, and many household utensils. The wheel reduces time considerably grinding and finishing these items. Tests have shown life of abrasive belts increased up to 200% or better. Since the belt is more flexible riding deep grooves, it can shake out dull abrasive and prevent glazing that shortens belt life.

The R-58 contact wheels—all one inch in width—are available in hardnesses or durometers. Color coded, the wheels can be combined for any width

ACCURACY
.0002 T.I.R.

.0002 T.I.R. or less at Spindle Nose, .0005 T.I.R. or less on Test Arbor six inches from Spindle Nose

SPINDLE SPEEDS 150 and 250 RPM Other Spindle Speed Pulleys Available

MODEL B943 MOTOR DRIVEN WORK HEAD

No. 11 B & S Tapered Spindle Standard Equipment. No. 12 B & S or No. 5 Morse Available at Slight Extra Cost.

Clip ad to your letterhead and send for Literature

K. O. Lee Company, Aberdeen, S. D.

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LEA GRIPMASTER®

Industry's Abrasive BONDING CEMENT for Wheels and Belts

GREATER FLEXIBILITY — Finer Breaks

Isn't that what you want in a wheel or belt . . . a condition that permits the abrasive grains to get into crevices and go around curved surfaces? A test of Gripmaster under your working conditions will prove it superior from this angle. Send for a generous size free sample, enough to let you make a convincing competitive test.

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14066 Stansbury Ave., Detroit 27, Michigan
(A member of the well-known Lea Group of Finishing Specialists)

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Detroit 27, Mich.

☐ Please send us your free sample of GRIPMASTER.
☐ Please send us literature giving full details.

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Company_____
Address_____ GF.4-57

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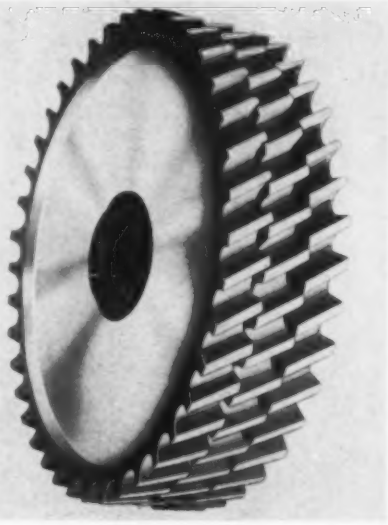

or hardness combination that may be necessary. When two or more of the wheels are used together they leave no pattern on the work. Each wheel consists of a pair of steel discs with deeply serrated tire made of specially compounded vulcanized rubber.

Chicago Rubber Co., Inc., Waukegan, Ill.

Use postpaid card. Circle No. 114

Grinding Wheel Gage

Consisting of either a three or four-column Precisionaire, the grinding wheel gage flows air into the grinding wheel and gages the flow by means of scale graduations known as the Sheffield index. While graduations have no relationship to abrasive grain sizes, the gage quickly and accurately compares and checks uniformity.

Extended tests by leading manufacturers and users of grinding wheels indicate the air gage is making possible effective non-destructive comparative tests of density uniformity in grinding wheels, honing sticks and other abrasive tools and products. This gage has disclosed differences in two supposedly identical lots of wheels and as a result manufacturing changes were

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BOND... the big reason why diamond wheels by J. K. Smit meet your requirements

EXPERIENCE... gained from many years of testing cementing mediums and fillers

QUALITY CONTROL... that insures even distribution of diamond particles throughout every wheel

ONE SOURCE... that manufactures all types of metal, vitrified and resinoid bond diamond wheels

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made for greater uniformity.

The gage positively detects filling and provides an accurate method of exploring structural variations. It enables machine tool builders and users of grinders to select uniform wheels for super-precise grinding jobs where wheels of varying density would be unsuitable.

Sheffield Corp., 721 Springfield St., Dayton 1, Ohio.

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Form and Cutter Grinder

A Swiss form and cutter grinding machine, Model FS 21, provides solution for the use of the reliable, sharp, edge pointed teeth on nearly any type cutter. The machine allows generation of the profile by grinding a land on the periphery of the teeth. The inclination of this land (the clearance angle) can be selected according to the material and modified at any time. Likewise the rake angle can be chosen to suit cutting conditions without any influence on profile. Contour grinding eliminates any heat treat warpage, keeps profile and teeth always exactly concentric to bore or shank.

The method used on this grinder is a simple hand copying of a template conforming to the profile. This machine

consists of a column, the articulated links with the floating work-table, the wheel-head and the dust extracting equipment. A grinding saddle carries the cutter, and below the tooth to be ground, a template with the exact profile of the finished tooth. The saddle can be easily moved horizontally due to the articulated links.

The Olkon Corp., 13823 West 8 Mile Rd., Detroit 35, Mich. •

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Diamond Dresser for Drill Grinders

A new diamond dresser, said to do a better, speedier job of wheel dressing, has been made standard equipment on all Sterling drill grinders according to the manufacturer.

Other improvements include the incorporation of the shifting lever used in models DB and DV in the model

DRESS RIGHT

More pieces ground per hour, more pieces per wheel . . . yours if you dress your grinding wheels regularly. Desmond dresser catalog free on request.

The only complete line of grinding wheel dressers and cutters

Desmond

THE DESMOND-STEPHAN MFG. CO., URBANA, OHIO

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Now... From one outstanding source!

All Your Diamond Abrasive Requirements

THE Star Dust LINE!

A COMPLETE RANGE OF LABORATORY GRADED DIAMOND ABRASIVES FOR EVERY PURPOSE

STAR DUST DIAMOND WHEELS AND HONES
Superior diamond quality combined with new bonding formula.

STAR DUST Laboratory graded Pure Diamond Powders

STAR DUST Laboratory graded diamond lapping compounds in 18 gram applicator gun—or in 5 gram ophthalmic tipped tube.

You can put your confidence in the STAR DUST line as so many others do because STAR DUST quality is consistent quality—the result of our special process of laboratory crushing and grading to achieve uniform nodular shape. That means *all* particles work for you. Be "Laps Ahead." For easier grinding and mirror finishes specify STAR DUST products.

Send for Catalogue GF-5

ACE ABRASIVE LABORATORIES

35 ROSELLE STREET MINEOLA, NEW YORK

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DA to make it easier to change setups for different drill diameters through a range from ⅛" to 2½". A micrometer drill feed is now available for all models and the models DB and DV can be obtained with 1 hp motors.

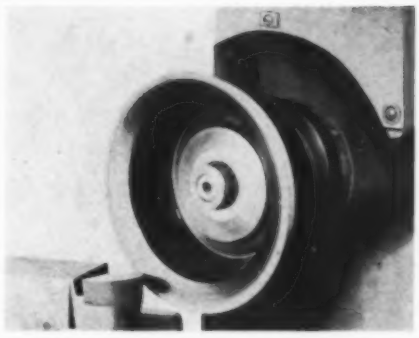
McDonough Mfg. Co., 1524 Galloway St., Eau Claire, Wis.

Use postpaid card. Circle No. 117

Diamond Impregnated Flaring Cup

An improvement in a D11B resin bond flaring cup helps it to be a definite cost reducer on all applications of carbide regardless of size or grade. Manufactured for dry grinding applications of carbide single point and multi-tooth tools, the new bond is designated as B "60".

With this bond, entirely new methods can be practiced in grinding carbide tools due to its ability to take larger amounts of stock on each single pass. Single passes of .005 dry is now accepted on multi-tooth cutters where in the past .0005 to .001 was recommended. Larger single passes for each blade



ground offers high production on grinding applications.

On most large cutters the flaring cup will grind completely around a full cutter and return to the number one blade still touching. This not only offers a true ground tool, but also provides long life.

It will be noticed that although larger feeds can be taken with the bond, there will be no chipping found along the periphery. This new wheel also has proven satisfactory where coolant facilities are available on tool and cutter grinders and plunge grinding is desired.

A.I.T. Diamond Tool Co., 8221 N. Kimball Ave., Skokie, Ill.

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Whether yours is a large, medium or small plant, it is quite possible that Anocut Electrolytic Grinding will pay you handsome dividends. Investigate it today for greater savings tomorrow!

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CUT ASSEMBLY TIME 55%

AT ALLIED CONTROL CO.
PLANTSVILLE, CONNECTICUT

Case History M-100

PROBLEM: A nylon-encased component for an electrical relay to be precision sized by milling both ends.

SOLUTION: Two PRECISE SUPER 50 POWER QUILLS mounted through plane mounts above and below working surface. Relay part is inserted between two .087" diameter carbide end cutting mills — milling completed to close tolerance as fast as operator can load and unload the fixture. Actual reduction in assembly time over previous method of operation — 55%!

Other Power Tools from ⅓ to 1½ H.P. and complete line of accessories described fully in our catalog, available Free on request.

SUPER 50 POWER QUILL PRECISION Features

1. Super Speeds — to 45,000 RPM at high torque under load.
2. Precision ground — satin chrome finished Steel Housing only 2½" D. and 9½" overall length.
3. Ground and honed Collet Chuck with up to ¼" capacity.
4. Available with complete line of mounts, filtration units and electric speed controls.
5. Used singly or in multiple set-ups.
6. Micro precision ball bearings with sealed-in lifetime lubrication insure chatter-free, vibration-less running, making possible tolerances of .0001".

Precise PRECISE PRODUCTS CORP.
3725 BLUE RIVER ROAD, RACINE, WISCONSIN
QUALITY AND PRECISION SINCE 1882

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Grinding and Finishing

News of Industry

Simonds Abrasive Locates in Los Angeles Area

One of the largest manufacturers in the grinding wheel industry, Simonds Abrasive Company now has a new plant at 9844 Rush Street, El Monte, California. This area was selected because of its location in the heart of the West Coast's rapidly expanding industrial and metalworking economy.

Backed by the company's 67 years' experience as a major manufacturer of grinding wheels, other bonded abrasive products and abrasive grain, the El Monte plant houses complete manufacturing facilities for the production of vitrified and resinoid bonded abrasive products. These include mixing, pressing, kilns and ovens for firing and special finishing equipment. Also included are complete service facilities for altering and working on grinding wheels, as well as large warehouse stocks of thousands of items.

Simonds Abrasive Company's main plant is located in Philadelphia. Additional branch offices and warehouses are maintained in Boston, Chicago, Detroit, Philadelphia, and Shreveport, La. The company is a division of Simonds Saw and Steel Company, Fitchburg, Mass., one of the world's largest producers of saws, files, knives, other cutting tools and special steels.

American Society for Abrasives

The Connecticut Chapter of the ASA was organized in January 1957 with 17 members. The first meeting for membership was held at the Log Cabin Restaurant in Wallingford in February with 192 present. At the March meeting Chapter by-laws were read and organization discussed further. The April meeting had as first speaker, Mr. Asher Nesbin of the American Grain Company, who delivered an excellent talk on abrasive grains in general. The J. K. Smit Company presented a movie on the mining of diamond with question-and-answer period following at the annual meeting in May. Election of officers at that meeting were as follows: president, **Howard E. Swatkins;** vice-president, **Robert G. Carpentier;** recording secretary, **Harold D. Rivers;** treasurer, **Patrick Pascucci,** and corresponding secretary, **Robert Nixon.**

The subject for the December 16 meeting will be "Grinding Machine Manufacturing" to be presented by Cincinnati Machine Company. Anyone wishing to receive notices of further meetings may write to Connecticut Chapter, American Society for Abrasives, Box 134, Plantsville, Connecticut.

Company Briefs

Elgin Abrasives Div. Launches Distributor Plan

A new tool stocking distributor program aimed at broadening its product coverage and improving customer service is announced by the **Abrasives Div.** of **Elgin National Watch Company.**

William H. Baudouine, division sales manager, said the division expects to have a nation-wide distributor plan in

operation by the first of the year. "The program primarily will be geared to expanding the market for Elgin's 'Electro-Ground' carbide end mills and standard rotary tools," Baudouine said.

The following distributors were appointed: in Arizona: **Roy J. Heyne Machine Co.,** 707 Buchanan St., Phoenix, and **Circle Sales Co.,** 9151 N. Ninth Ave., Phoenix; in Northern Ohio, **Clark-Campbell Tool Sales Co.,** 4673 Landchester Rd., Cleveland; and in Central Indiana, **Browning Tool and Supply Co.,** 332 N. Capitol Ave., Indianapolis.

The Elgin rotary tool line, sold under the name of "Golden Circle" tools, includes a complete line of solid carbide end mills, drills, burs and reamers.

Abrasives to be Sold Through Distributors

Skil Corp. has announced that its new Perma-Grit T-C abrasives will be marketed to industrial, automotive and construction users through industrial distributors and mill supply houses. The only exceptions will be in original equipment manufacture, where manufacturers and machine design engineers adapt existing machines or build new ones to utilize the long-lasting Skil abrasives.

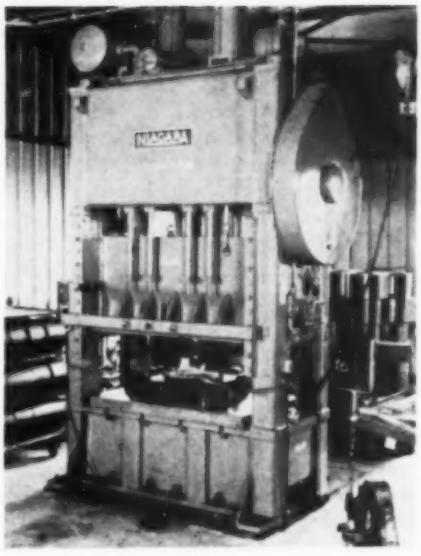
Blower Wheel Company Expands Facilities

The four-year $3¼ million development program of Morrison Products, Inc. of Cleveland, Ohio, manufacturers of blower equipment for heating air conditioning and safety guards for portable grinding tools, is nearing completion.

Automation is the key to the latest phase. The new installations are designed to increase the company's production flexibility and make possible a wider variety of types and sizes of parts in all phases of the company's business. Over two-thirds of the total program has been accomplished. The company's Cleveland plant has been expanded structurally to accommodate a new shear-room and new shearing equipment for the handling of coil steel stock.

Blower wheel production lines have been almost doubled. Big press equipment has been installed to turn out blower components and to enlarge the range of the company's contract stamping operations. Illustrated is a 200 ton Niagara press, recently installed, to help enlarge operations. This press has a 72-48" bed, a stroke of 8", a shut height of 30", and operates at 30 strokes per minute.

Paint-tank arrangements and con-



veyor lines have been organized to make possible quickly and easily to produce blower wheels finished to the exact requirements of heating, airconditioning and evaporative cooling manufacturers. Important laboratory equipment has been installed to implement the company's engineering services to its customers.

Personnel Briefs

William J. Snyder has been named special sales representative for the Tube Reducing Corp. Snyder will handle the Niphos nickel-alloy corrosion resistant process.

Raymond G. Dargis has been appointed technical sales representative for MacDermid Western Inc., Ferndale,

Your Spindles SERVICED or REBUILT in HOURS ...not weeks

Here's your spindle ready for reassembly. New super precision bearings from our complete stock of all types of spindle bearings are installed. We've cleaned and checked every part of this spindle for misalignment and flaws—It's ready to go back together for a series of exacting "run-in" tests to make certain the dirty, worn out spindle we received just hours ago is returned to you ready to perform as well or better than it did when the spindle was new!

Gentlemen:

I'd like to have complete information on your spindle repair service.

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Firm .....

Address .....

City..... Zone..... State.....

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PRESURELOK®-224

RESINOID DIAMOND WHEELS

The *Best* Diamond wheel ever developed

- U.S. DIAMOND'S PROVEN REVOLUTIONARY "PRESURELOK"® Process increases Diamond holding efficiency by 300%.
- Positively no danger of heating or cracking carbide with the most rapid stock removal.
- Use dry or with coolants.
- They are consistently super-finishing, out-producing, under-costing any other Diamond wheel ever produced . . . and they are always readily available.
- If you have used them, you know they are the best! . . . If you haven't, let us show you!

UNITED STATES DIAMOND WHEEL CO.
835 ILLINOIS AVENUE
AURORA ILLINOIS

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Mich., manufacturer of metal cleaning, plating and finishing chemicals. He has been assigned to the Detroit area.

James R. McConnel, has been appointed to the newly created position of manager, abrasive sales, Pangborn Corp., Hagerstown, Md., manufacturers of dust collectors and Rotoblast equipment. McConnell's appointment follows 10 years of experience in the abrasives field.

PHILADELPHIA — **General Grinding Wheel Corporation** announced the election of **Clarence Tolan, Jr.** as chairman of the board of directors and **Jacob S. Disston, Jr.,** as vice-chairman of the board of directors of the corporation. Mr. Tolan was formerly president of Dodge Steel Company and Mr. Disston was formerly president of Henry Disston & Sons, Inc. both of Philadelphia.

David B. Swarr has been appointed an abrasive engineer for the **Bay State Abrasive Products Company,** it was announced recently by John M. Mele, Philadelphia district manager. Mr. Swarr, graduate of Bucknell University, has been employed in the field of industrial sales. His duties will consist of offering abrasive engineering service for the Westboro firm in the Philadelphia area.

David B. Swarr

American Buff Co., Chicago manufacturer of a wide line of buffs for the metal finishing industry, announces the expansion of its sales staff with the appointment of **Bob Hulland** as sales and service engineer for the Syracuse, New York area. After four years active duty with the Marine Corps, he entered the die-casting industry as a die-cast operator and then became a tool and die maker. After serving as journeyman tool and die maker, he spent two years as Chief Inspector with Precision Casting Co., Chicago. Since 1954 he has served as Plant Superintendent for Univex Die Cast and Engineering Co. of Dearborn, Michigan, where he lives with his wife and four children.

Robert J. Edwards has been appointed sales supervisor, Armour and Company, Coated Abrasives Division, Alliance, Ohio, and will supervise both industrial and retail sales in Rhode Island and Connecticut. Prior to this appointment, he was sales supervisor of retail sales in New York City. Mr. Edwards is a graduate of the University of Bridgeport and Champlain College and attended schools in Bronx, New York.

The **Landis Tool Company,** manufacturer of precision cylindrical grinders, has appointed the **R. O. Deaderick Company,** Orlando, Florida, exclusive distributor for Landis grinders in the Central Florida area.

James E. Shondel has been appointed to the position of government sales manager by the International Research and Development Corporation, Columbus, Ohio.

James E. Shondel

A graduate of Ohio State University in Industrial Engineering, and of Franklin University in Law, Mr. Shondel comes to the firm from Air Force Procurement. A professional engineer's license, a pilot license, a member of the Ohio Bar, and three years in the Corps of Engineers, provided him the varied background required for his new position.

Tracy Gilbert, Richard Welton and **Ralph Watson** have been appointed sales supervisors. Mr. Gilbert's territory will be Toledo and surrounding area of Ohio. Mr. Watson will handle industrial and retail sales for St. Louis; Mr. Welton for the adjoining area.

Mr. Gilbert was a student at the University of Toledo. He has had various sales positions before his Armour appointment. Mr. Welton received his M.B.A. degree from the University of Chicago and his B.S. degree from the University of Nebraska. Prior to his Armour appointment, he was a salesman with Remington Rand Company. Mr. Watson attended public schools in Alton, Illinois, and Los Angeles, California. He was a salesman for the National Rocket Company before coming to Armour.

Various appointments have been made within the past few weeks at Coated Abrasives Division, Armour and Company, Alliance, Ohio. **K. Emerson Wilhelm** became the new regional sales manager for Northern Ohio with headquarters in Cleveland. Mr. Wilhelm has been sales supervisor since August

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1950 in Cleveland and Massillon, Ohio. In his present capacity he will supervise Ohio regional sales for both industrial coated abrasive and retail Handy Home Products.

Robert Cushman

McCune, Jr.

Norton Company has created two new positions in the sales management of its Abrasive Division, to become effective January 2, 1958. **Robert Cushman** will become manager of marketing services and **W. Alexander McCune, Jr.,** will become manager of field sales.

In his new position, Mr. Cushman will be responsible for the Sales Engineering Department, Sales Service Department and Distributor Sales Promotion Department. He is a graduate of Phillips Academy and Dartmouth College. From 1945 to 1952, Mr. Cushman was an abrasive engineer for Norton Co. in the Syracuse, N. Y. area. The next three years he served as district manager on the West Coast. Since 1955, he has been assistant sales manager of grinding wheels.

Alexander McCune, Jr. will have complete responsibility for the supervision of the field sales force and for carrying out the policies, procedures and programs agreed upon by sales management. He is a graduate of Dickinson College. From 1946 to 1953, he was an abrasive engineer in New Jersey, and has served the past four years as general sales manager of the Norton Company of Canada, Ltd., at Hamilton, Ontario.

Arthur K. Hanchett, former president and director of the Hanchett Manufacturing Company, Big Rapids, Michigan and Portland, Oregon, died after a prolonged illness in Big Rapids, Michigan, Saturday, October 19, 1957.

He obtained his B.S. degree in 1902 from the University of Michigan. After graduation he joined his father in the manufacture of and development of saw swages and automatic saw sharpening machines. His engineering skill and practical knowledge resulted in the development of many new and advanced types in this field. Actively engaged in plant management and manufacture, he was advanced to the presidency in 1927, in which capacity he served until 1946. At that time he retired from active management of the company to serve on the Board of Directors in an advisory capacity until his death.

Ray Parker, recently appointed Eastern Michigan representative for American Buff Co., Chicago, died Sunday, October 13, after a heart attack. His untimely death closed a life brimming with activity and interest in both the metal finishing industry and leisure sports. His business rise, starting with work on the wheel, took him up through shop supervision to specialization in stainless steel metal finishing and consulting engineer in this field. In 1956 he was appointed Eastern Michigan representative for American Buff. He is survived by his wife, Julia, and two children.

Abrasive and Ceramic Products Manufacturer has capacity available. Equipment—Pug mills, Simpson mixer, Haller press and gas fired Kilns. Low overhead costs.

GRINDING & FINISHING
222 E. Willow, Box No. 14 Wheaton, Ill.

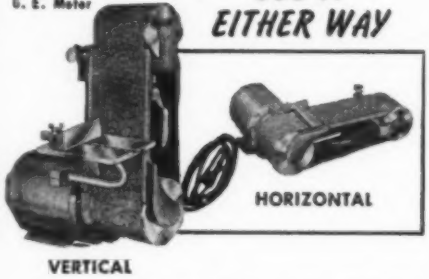
ATTENTION
Agents & Shop Personnel
Agents wanted to sell new silicone base, all purpose, barrel finishing compound. Shop personnel may act as agents in spare time. Confidential.

Grinding & Finishing
222 E. Willow, Box No. 17, Wheaton, Ill.

WALLS TU-WAY BELT SANDER

USE IT EITHER WAY

Full 1/3 h.p. G. E. Motor



At last, a top quality industrial sander that provides all the most wanted features — yet sells for so little.

complete with cord, plug, switch ready to use **$89.95**

Illustrated Literature on Request
A few desirable distributor territories still available.

WALLS SALES CORPORATION
333 Nassau Avenue Brooklyn 22, N. Y.

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BETTER CUT WITH BEAVER CUT CARBIDE

Cushion Ground and Micro-Lapped Rotary Files, Grinding Burrs, and Center Lapping Tools outlast regular ground carbide tools by 30% yet cost no more.

You may make a greater saving by sending us your dull tools for sharpening by our manufacturing method.

Beaver Cut Rotary File Company
401 E. Slauson Ave.
Los Angeles 11, Calif.

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95% Diamond Hardness at 1/3 Diamond Cost!

HONING LAP

Highly efficient, ATECO's new Honing Lap removes material fast. This convenient, economical, durable lap produces an absolutely smooth finish on tool steels and on the hardest carbide tools. Macolaepp grains used in the new ATECO lap are harder than the toughest sintered carbide. Long life, even cutting action guaranteed.

There is a proper ATECO Honing Lap for each job, depending on the finish desired and amount of material to be removed. Grits —160, 220, 360, 500. Send Your Order today! **$8.75**

MICRO DIVIDER SETTER

$7.50

A new device for precision setting of dividers. Accuracy to .001". Valuable aid to tool makers, draftsmen, lofting engineers, and layout men. Complete with case.

Write for full details!

ATECO
AIR TRANSPORT EQUIPMENT, INC.
AMITYVILLE, NEW YORK

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A GUARANTEE FOR YOUR CRYSTAL LAKE GRINDER

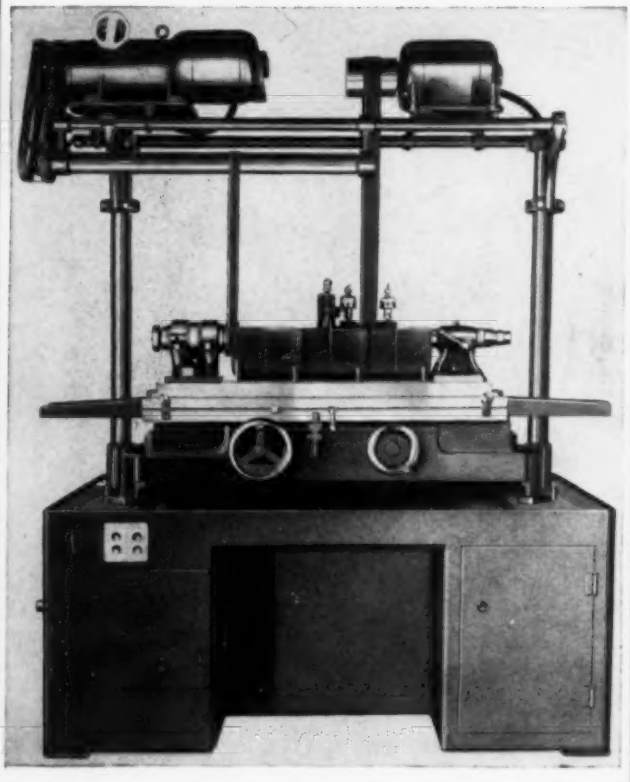
When purchasing a REX SUPERVAN HIGH SPEED STEEL SPINDLE for your Crystal Lake Grinder an additional $50.00 to the purchase price will give you a TWO YEAR SPINDLE GUARANTEE.

EASY OPERATION: CLOSE TOLERANCES:

ACCURACY: FINE MICROINCH SURFACE FINISH

A CRYSTAL LAKE GRINDER will hold size as well as grind round from .000005 to .000020" and finish from One to Four Microinch SURFACE FINISH. The essentials in grinding are a round spindle, taper bearings, a spindle that can be adjusted periodically without the squashing of bronze boxes and to have belt pressure ninety degrees from grinding pressure so the bronze boxes will not wear out of round.

For example, fuel injectors, after having been rough ground, can be ground to .000010" roundness with a sixty grit wheel and one pass of the wheel.



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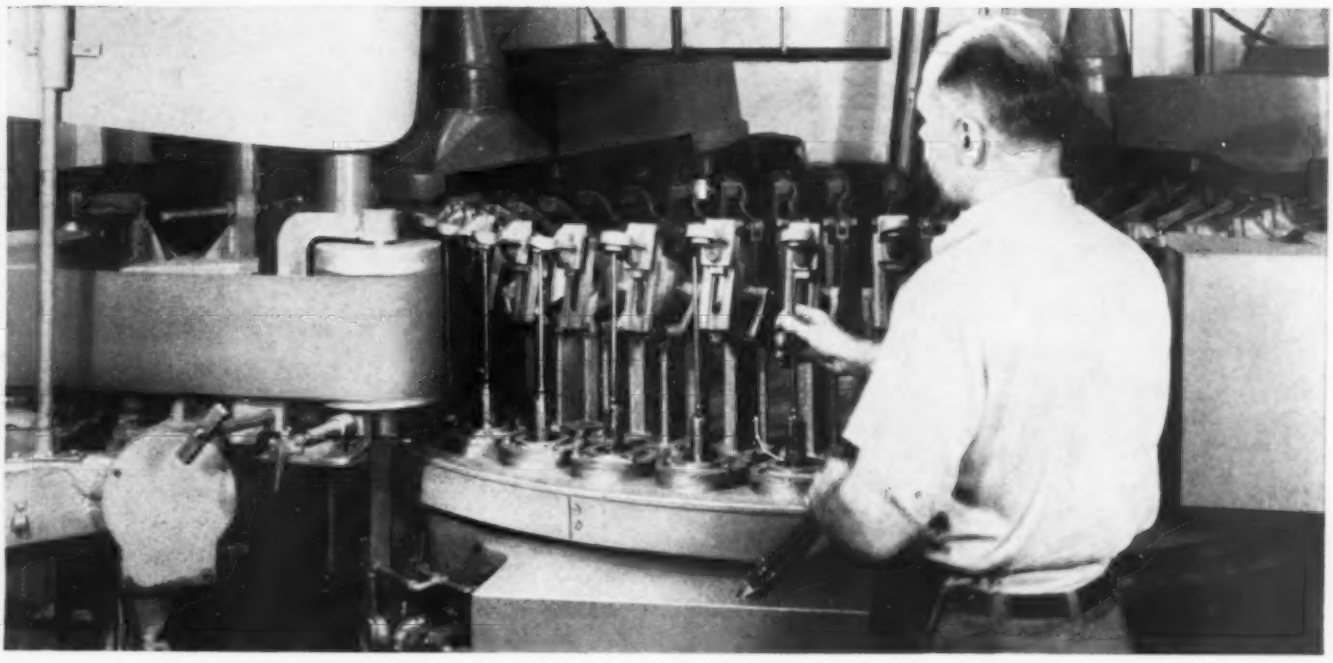

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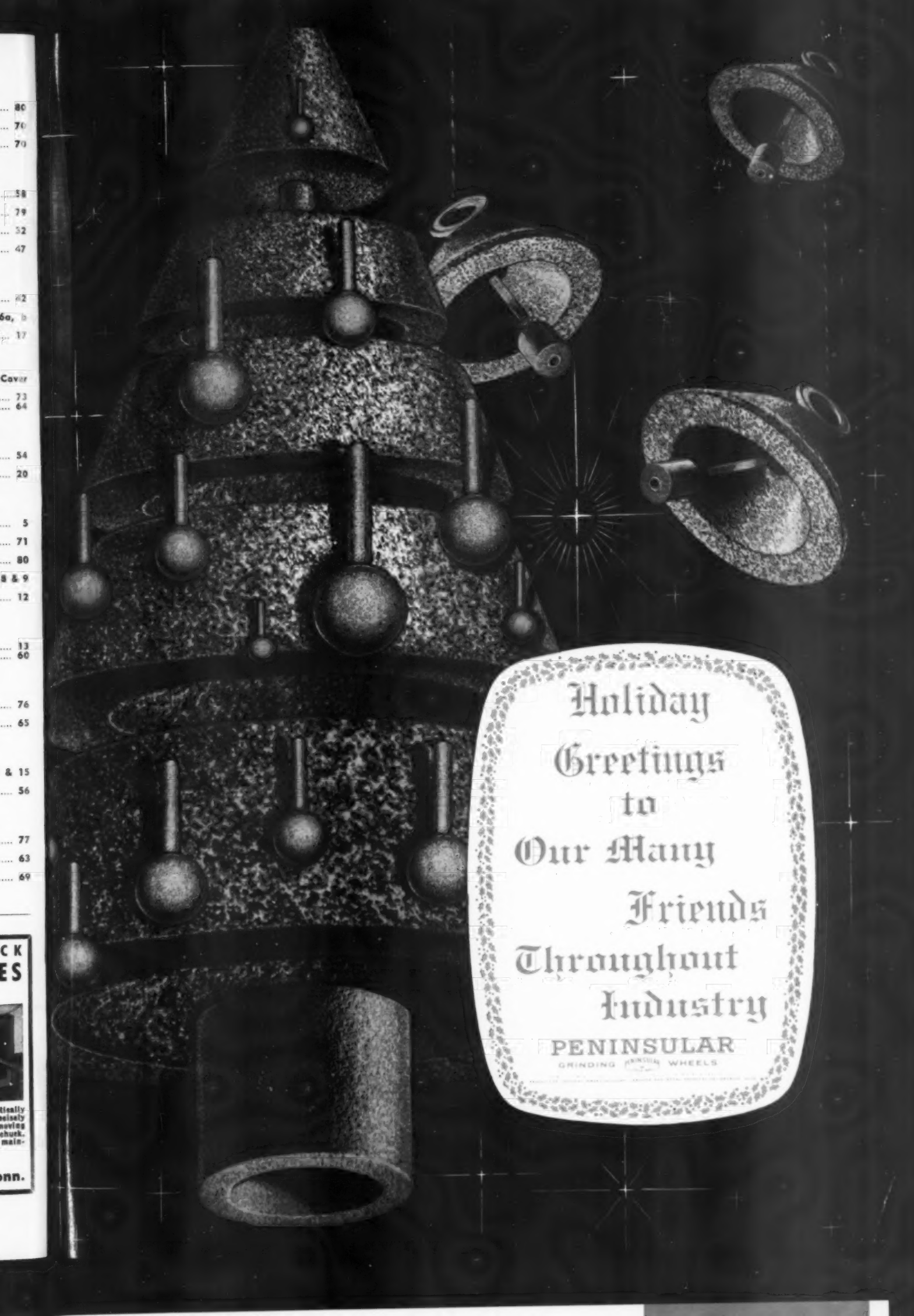
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No. 3 of a Series

Photos: Courtesy The Emerson Electric Mfg. Co., St. Louis

e.g. electric motor stators

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